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Solving warfighter capability requirements through venture capital

Hoefferle, Shenendoah.; Schaefer, Joseph V.; Newman, Jason B.

Monterey, California. Naval Postgraduate School

NAVAL POSTGRADUATE SCHOOL

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MBA PROFESSIONAL REPORT

Solving Warfighter Capability Requirements through Venture Capital

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By: **Shenendoah Hoefferle,**
Jason B. Newman, and
Joseph V. Schaefer

December 2006

Advisors: **Nayantara Hensel,**
Alan J. Laverson

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This project explores the use of a VC firm, technology transference, USAF policies and procedures, required USAF infrastructure, and funding. Ultimately, the product from this research is an implementation plan for a USAF VC initiative.

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SOLVING WARFIGHTER CAPABILITY REQUIREMENTS THROUGH VENTURE CAPITAL

Shenendoah Hoefferle-Captain, United States Air Force
Jason B. Newman-Captain, United States Air Force
Joseph V. Schaefer-Captain, United States Air Force

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December 2006

Authors: _____
Shenendoah Hoefferle, Capt, USAF

_____
Jason B. Newman, Capt, USAF

_____
Joseph V. Schaefer, Capt, USAF

Approved by: _____
Nayantara Hensel, Lead Advisor

_____
Alan J. Laverson, Support Advisor

_____
Robert N. Beck, Dean
Graduate School of Business and Public Policy

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SOLVING WARFIGHTER CAPABILITY REQUIREMENTS THROUGH VENTURE CAPITAL

ABSTRACT

The objective of this project is to explore the concept of Venture Capitalism (VC) as a vehicle for technology transference. Currently, the United States Air Force (USAF) relies on an inefficient timeline for research and development to acquire new technologies. In an effort to improve efficiency in technology development the USAF needs to adopt alternative processes such as VC.

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I. INTRODUCTION

A. BACKGROUND

According to Secretary of Defense Donald Rumsfeld, the DoD acquisition process is not getting new systems to the field quickly enough. Our current average acquisition response time is 10 years, longer for major weapon systems. We are delivering technology that is at least a generation old. To reverse this trend, we must change our ways of doing business. This starts by taking advantage of private sector expertise and forging a new compact with the warfighter.[1] These comments, and those that follow, provide insight into the reason why Secretary Rumsfeld has attempted to transform the way DoD does business. When Secretary Rumsfeld spoke to the Senate Armed Services Committee on June 21, 2001, he recognized the new state of the world and the need for increased speed in the acquisition process. "The new threats are on the horizon. And with the speed of change today – where technology is advancing not in decades but in months and years – we cannot afford to wait until they have emerged before we prepare to meet them. After the new threats emerge, this opportunity may not be available. The risks of transformation could be much greater then – perhaps unacceptably so".[2] The DoD Acquisition System is set-up to reduce the risk of failing and is not known for its speed in execution.

Congress has recognized the rigidity of the defense acquisition system when they issued the 2003 Defense Appropriations Act. They stated "…Navy's research and acquisition community historically has had great difficulty in transitioning innovative technologies from government research organizations and the commercial marketplace to active development and procurement programs. Due to the constraints of internal planning and budgeting processes, and the stifling legacy of `programs of record', new

[1] Air Force Institute of Technology. *Acquisition training.* Retrieved October 25, 2006, from http://www.afit.edu/ls/knowledge/KO-04/DOD5000_KO04.htm.

[2] Experiences and recommendations for innovation and defense transformation: House Armed Services Committee Joint Subcommittee Hearing of the Tactical Air and Land Forces Subcommittee and Projection Forces Subcommittee, House of Representatives, (2005). Retrieved September 2006, from http://www.house.gov/hasc/Carroll6-29-05.pdf#search=%22quote%20rumsfeld%20DoD%20Acquisition%20process%22.

Navy systems are often fielded with a high degree of technological obsolescence…."[3] While the comments were made in relation to the Department of the Navy one can draw the same conclusion for the Air Force in terms of the dilemma we have in bringing innovative technologies to the warfighter. This correlation can be drawn because the Air Force and Navy both play by the same rules of the defense acquisition system. Why has the DoD which used to be a leader in research and development efforts suddenly having difficulty in bringing new technologies to the warfighter quickly?

One reason is the lack of real competition among defense contractors. In 1985, defense programs were conducted in a robust market environment where over 20 fully competent prime contractors competed for multiple new programs each year. The industrial base was supported by huge annual production runs of aircraft (585), combat vehicles (2,031), ships (24) and missiles (32,714). Most important, there were well-known, well-defined threats and stable strategic planning by the Department. Today, the Department relies on six prime contractors that compete for fewer and fewer programs each year. In 2005 reductions in plant capacity have failed to keep pace with reduction in demand for defense systems, (188 aircraft, 190 combat vehicles, eight ships, and 5,072 missiles).[4] This reduced pool of competitors has also reduced the pool of innovative thinkers to solve the defense department's problems.

Another reason is the shift in the primary sources of research and development spending in the United States. Prior to the 1970's, the federal government was the largest contributor to U.S. R&D. Since then, the federal government's contributions have remained fairly flat in constant dollars, while industry has shown growth in funding U.S. R&D each year.[5] This funding shift has actually helped reduce the pool of available contractors who found themselves competing for ever shrinking resources.

Combine the rigid acquisition processes of the DoD, the reduced funding and the reduced contractor pool and you have the Air Force's dilemma today. A proposed

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3 Department of Defense Appropriation Act, 2003, House Report 107-532U.S.C. (2003).

4 Defense Acq performance assessment.

5 Kei Koizumi, "R&D Funding Trends in the US Government," American Association for the Advancement of Science (2005), 27 October 2005. Retrieved August 15, 2006, from http://www.aaas.org.

solution to this dilemma that other government agencies have successfully implemented is venture capital. The ability to leverage commercial resources while obtaining the technologies needed to fill an agency need has brought about the CIA's In-Q-Tel program and the Army's On-Point initiative. Both programs use government funds to finance small, upstart businesses in order to achieve their goals.

The purpose of this paper is to explore the potential for an Air Force venture capital fund to meet the technology needs of the warfighters. We accomplish this by first describing the current traditional acquisition process to understand where the time goes when researching and developing a new technology. We then look into other defense programs that are similar to venture capital, but have different purposes and are operated on a smaller scale. After outlining the multiple programs available we explore if venture capital will complement the existing programs. In the event venture capital does fit in with the existing programs we provide a recommended model on how an Air Force venture capital program should be structured and operate.

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II. ACQUISITIONS TIMELINE

A. WAY AHEAD FOR TRANSITION

With the issuance of the Department of Defense's Transformation Guidance in April 2003, Secretary of Defense Donald Rumsfeld set a bold, innovative strategy for transitioning the Armed Forces. He stated "as we prepare for the future, we must think differently and develop the kinds of forces and capabilities that can adapt quickly to new challenges and to unexpected circumstances. We must transform not only the capabilities at our disposal but also the way we think, the way we train, the way we exercise, and the way we fight. We must transform not only our armed forces but also the Department that serves them by encouraging a culture of creative and prudent risk taking. We must promote an entrepreneurial approach to developing military capabilities; one encourages people to be proactive, not reactive, and anticipates threats before they emerge."[6] Under this guidance, the department of defense set out to transform its business practices and harness operational synergy between the services.

With the shift to a more agile and proactive force, the current acquisition process needs to change to keep up with the paradigm shift. As it stands, the current model is cumbersome and unresponsive to technological change. This is counterproductive to the vision as laid out by the Secretary of Defense. In the near term, it doesn't meet the warfighter needs of rapid technology transference. Secretary Rumsfeld outlined key transformation drivers to expedite the top-down change.

1. Transformation Drivers

The critical focus of the transformation drivers is on speed and efficiency to the end user; the warfighter. Two of the key transformation drivers are; 1) support for joint warfighting capability and 2) reduced cost of business operations. Greater commonality is needed between the forces and the Department of Defense. The Department's business

[6] Commander, US Joint Forces Command. (2004). Delivering innovation: The joint concept development and experimentation campaign plan FY 2004-2011.

infrastructure must be compatible with the global, networked military it supports.[7] As the USD (AT&L) website states "Defense business operations are being streamlined so that DoD can more effectively deliver warfighting capabilities, deal with growing pressures on resources, and benefit from economies of scale. Costly and outdated systems, procedures, and programs tax resources from warfighting and stifle innovation. The nation's defense dollars must be better applied to mission effectiveness and sustaining an effective long-term force posture."[8] In order to be cost effective and deliver the needed capabilities to the warfighter, a revolution in the way we do business needs to occur.

2. Defense Acquisitions Framework

The present era of rapidly evolving technologies and uncertain, explicit threats makes it undesirable to take 15-20 years to develop and produce a new defense weapon system. The Department of Defense's Acquisition tutorial states "a 21st century acquisition process must encourage efficiency, flexibility, creativity, and innovation in order to provide modern technology to the warfighter in a timely manner."[9]

DoD Series 5000 sets the framework and guidelines for Defense Acquisitions. These directives and policies differ from past versions because they:

- Encourage innovation and flexibility.
- Permit greater judgment in the employment of acquisition principles.
- Focus on outcomes vice processes.
- Empower program managers to use the acquisition system vice being hampered by over-regulation.[10]

The overarching process focuses on delivering capabilities and improvements as fast as possible. Innovations, such as evolutionary acquisition and time phasing of

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[7] Defense Business Transformation Office. (2006). *Fact sheet: Business transformation overview.* Retrieved October 15, 2006, from http://www.dod.mil/dbt/facts_overview.html.

[8] Defense Business Transformation Office. (2006). *Reduced cost of business operations.* Retrieved October 15, 2006, from http://www.dod.mil/dbt/mission_reduced-cost.html.

[9] Defense Acquisition University. (2004). *Defense acquisition process tutorial.* Retrieved September 15, 2006, from http://akss.dau.mil/darc/TUTORIAL/index.htm.

[10] Defense Acquisition University. (2004). *Defense acquisition process tutorial.* Retrieved September 15, 2006, from http://akss.dau.mil/darc/TUTORIAL/index.htm.

requirements emphasize the need to rapidly deploy technology to the warfighter. Also, the 5000 series addresses interoperability, supportability, and affordability. However, even with these transformation initiatives and revisions in policy, the acquisition life cycle and process framework can still limit reaction time and adversely affect the rapid transference of technology. There are two distinct phases that run parallel throughout the framework. They are the Joint Capabilities Integration Development System (JCIDS) and the Acquisitions Life Cycle Model. Both are independent, however, they rely heavily on inputs and outputs from each other.

Each part of the process takes time and each has requirements to advance to the next level. Throughout the process, there are several bottlenecks that can potentially occur, increasing the overall life cycle time. We'll analyze the notional timeline, and we'll compare it to real-world situations where the process slowed down the acquisitions process. On average, it takes about 2-4 years for a program to make it to the Milestone B decision point (Figure 1).

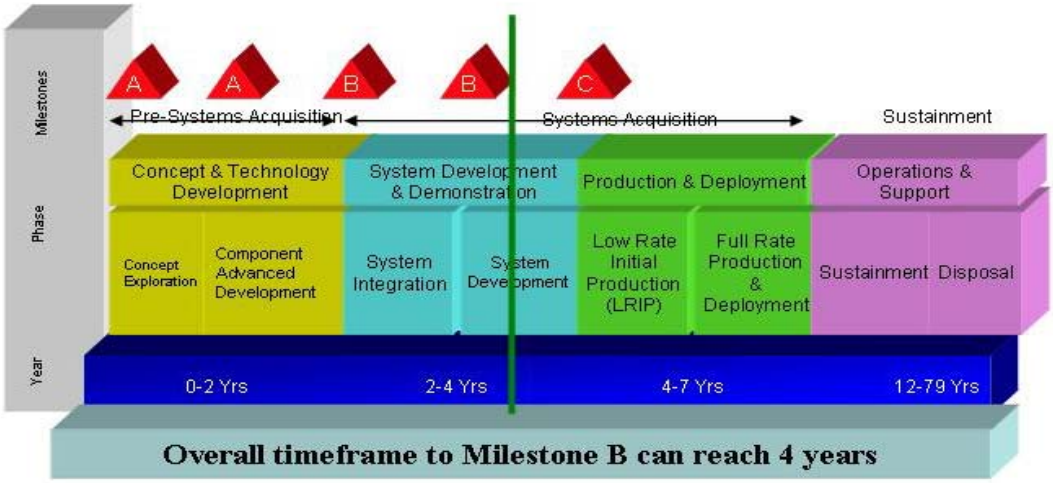

Figure 1. Acquisitions Timeline (From: Nussbaum)

The first section we'll review is the JCIDS. The JCIDS was DoD's answer to ensuring "jointness" with capability requirements.

B. JCIDS PROCESS

The JCIDS was designed to realize the transformation efforts and focus synergies on joint solutions, rather than service-centric piece meals. Two months after Secretary Rumsfeld introduced his innovative transformation initiative, the Joint Chiefs of Staff issued CJCSI 3170.01C, which radically altered the acquisitions process, and set about transforming the framework to meet the vision. JCIDS is the formal DoD procedure which defines acquisition requirements and evaluation criteria for future defense programs. JCIDS was created to replace the previous service-specific requirements generation system, which allegedly created redundancies in capabilities and failed to meet the combined needs of all three US military services.[11]

JCIDS realizes the demand to meet the needs of and sustain joint forces. It is the response of the Joint Chiefs to the Combatant Commanders need for flexible, distributed, and highly-networked operations. JCIDS implements a capabilities-based approach that utilizes the expertise of different government agencies, industry, and academia. JCIDS

[11] Wikipedia Contributors. (2006). *Joint capabilities integration development system.* Retrieved August 22, 2006, from http://en.wikipedia.org/wiki/JCIDS.

encourages collaboration between users (COCOMs) and materiel providers early in the process, and enhances the ability of organizations to influence proposed solutions to capability shortfalls. JCIDS also defines interoperable, joint capabilities that will best meet future needs. The broader DoD acquisition community must then deliver these technologically sound, sustainable, and affordable increments of militarily useful capability to the warfighter.[12] In other words, the decades-old "threat-driven," bottom-up" development process of warfare-material requirements was summarily replaced by a "revolutionary," "capabilities-driven," "top-down" process.[13]

1. Flow during Pre-Concept Phase

Joint Concepts are fed into by the DoD Strategic Guidance. Based on the Joint Concepts, a Functional Area Analysis (FAA) is done. It identifies the operational tasks, conditions, and standards needed to achieve military objectives.[14] A Functional Needs Analysis (FNA) is then built based off of the FAA. The FNA produces a list of capability gaps that require solutions and indicates the time frame in which those solutions are needed. It may also identify redundancies in capabilities that reflect inefficiencies. The FNA feeds the Joint Capabilities Document (JCD). The JCD effectively replaces the Mission Needs Statement (MNS) submitted by the users. The JCD represents the COCOM's (or user) needs with an emphasis on joint "goodness of fit" within the DoD. Services and other DoD components may develop ideas and concepts leading to draft JCDs.[15] JCDs are developed to highlight joint capability needs that will be further analyzed by sponsors for possible solutions. The focus on this process is establishing COCOM participation throughout the concept development stage, as opposed to simply submitting a MNS for a service-specific need.

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[12] Defense Acquisition University. (2006). *Defense acquisition guidebook: JCIDS.* Retrieved September 3, 2006, from http://akss.dau.mil/dag/DoD5000.asp?view=document&rf=Guidebook/IG_c1.3.asp.

[13] D.F. Mathews. (2004). The new joint capabilities integration development system (JCIDS) and its potential impacts upon defense program managers (Acquisition Research No. NPS-PM-04-017). Monterey, CA: Naval Postgraduate School.

[14] Chairman of the Joint Chiefs of Staff. (2005). CJCSI 3170.01E joint capabilities integration and development system.

[15] Chairman of the Joint Chiefs of Staff. (2005). CJCSI 3170.01E joint capabilities integration and development system.

The solution identification phase is called Functional Solutions Analysis. All possible solutions, both non-material and material, are identified and analyzed. The product of these reviews and analysis is the Initial Capabilities Document (ICD). The ICD proposes a range of approaches based on analysis of the cost, efficacy, sustainability, environment, and risk posed by the approaches under consideration. These are further refined and supports the ICD helps to shape and provides input to the AoA that will be used through the life of the system. The ICD is due at the Concept Decision and at Milestone A. For non-material solutions or minor material approaches, a DOTMLPF Change Recommendation (DCR) is created. The issuance of the ICD or DCR ends the pre-concept phase for the JCIDS process (See Figure 2).

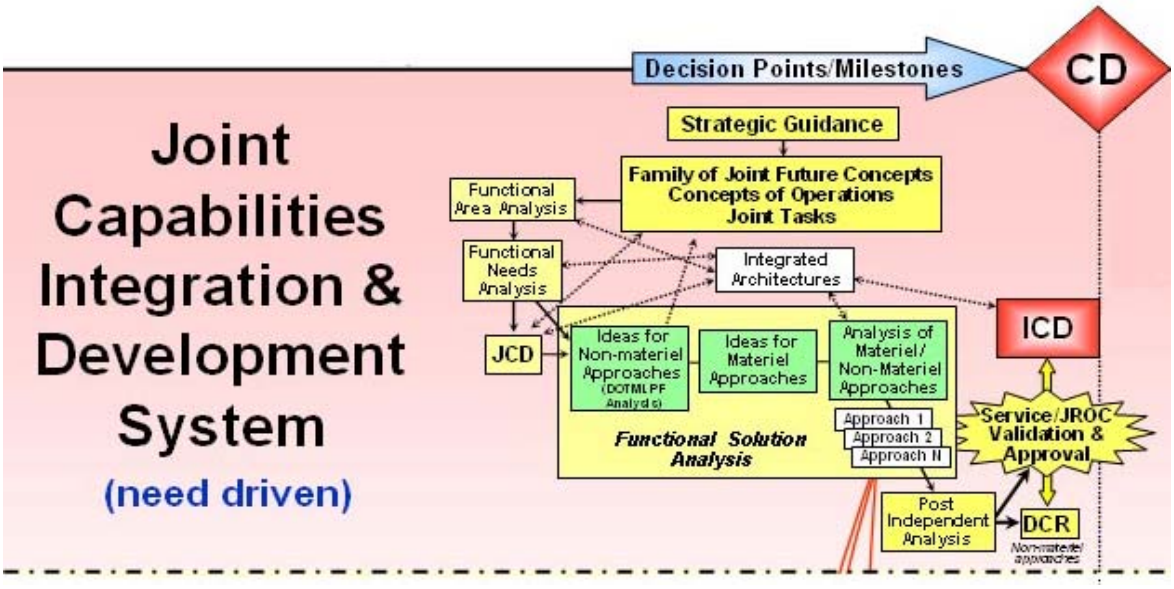

Figure 2. JCIDS Process (From: https://acc.dau.mil/ifc/index.htm. Retrieved September 2006)

There is no standard timeline for the issuance of the ICD or DCR. However, the process can actually take approximately 6 months based on the capability needed. One real-world example involves the Army's Palatalized Loading System (PLS) in 1986. The PLS was a technology invented by the British. It allowed one personnel to load up to 8 tons of equipment via the automatic lift system. However, the bottleneck came after the Army decided that the current load of 8 tons wasn't sufficient. Even though the Army

had a proven capability, it decided to re-scope the whole project as a 32 ton load project. This added approximately one year of time to the development of the Requirements Operational Capability Document, which is the precursor for the ICD.[16]

All JCIDS documents flow through a structured staffing/approval process which runs concurrent with this capabilities-based assessment. There are four designators within the JCIDS staffing process. All major programs, including ACAT 1/1A, require Joint Requirements Oversight Council (JROC) approval and are designated as JROC interest. The JROC assists the Chairman of the Joint Chiefs of Staff in identifying the priority of joint military to meet the national military strategy, and assist the Chairman in considering alternatives to any acquisition program that has been identified to meet military requirements by evaluating the cost, schedule, and performance of the program.[17] ACAT II are designated Joint Integration and require interoperability certification. A Joint Information designation provides all services information on the program. Finally, the independent designator requires no joint force affect or need for certification. JROC Interest items are sent to one of eight Functional Capability Boards (FCBs). The FCB brings all stakeholders together for common review and issue resolution. Also, the FCB prioritizes and assesses capability gaps and proposals.[18]

Staffing approval and documentation timelines for JROC interest items are 86 days.[19] So, at a minimum, JCIDS effectively adds 3 months to any capability timeline. Again, this requirement timeframe is absent of any renegotiation or critical changes, which can occur at any point throughout the process, effectively halting the program.

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[16] B. Naegle. (9/6/2006). *In-person interview.*

[17] Title 10, Subtitle A, Part I, Chapter 7, Section 181 Joint Requirements Oversight Council, 181 (1996).

[18] D. Kuhlman. (9/272006). Presentation: Joint staff capability based process.

[19] Chairman of the Joint Chiefs of Staff. (2005). CJCSI 3170.01B operation of the joint capabilities integration and development system.

Joint Integration and Independent Staffing requires the same set timeframe through the JCIDS process.[20] Once the decision is made to end the pre-concept phase, the concept refinement (CR) phase begins.

2. Flow during Concept Refinement Phase

This represents the first phase of the Defense Acquisition Management Framework as defined and established by DoDI 5000.2. The purpose of this phase is to refine the concept documented in the ICD and to prepare a Technology Development Strategy (TDS). The TDS will be discussed later. The Milestone Decision Authority (MDA) decision to begin CR does not constitute program initiation of a new acquisition program.[21]

Based on the Joint Concepts developed earlier in the JCIDS process, a draft Capabilities Development Document (CDD) is developed. The CDD is a document that captures the information necessary to develop a proposed program. The CDD outlines an affordable increment of militarily useful, logistically supportable, and technically mature capability. The CDD is needed to support the future Milestone B decision review.[22] Milestone A ends the Concept Refinement stage and begins the Technology Development stage.

3. Flow during Technology Development Phase

Milestone A decision approval initiates the Technology Development Phase. The purpose of this phase is to reduce technology risk and determine the appropriate set of technologies to integrate into the full system.[23]

The draft CDD flows through the Joint Staff for certification. Concurrently, several items are used to develop the certification. First, the Key Performance

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[20] Chairman of the Joint Chiefs of Staff. (2005). CJCSI 3170.01B operation of the joint capabilities integration and development system.

[21] Defense Acquisition University. *Glossary: Concept refinement phase.* Retrieved October 13, 2006, from http://akss.dau.mil/jsp/GlossaryAbbreviations.jsp?acronymId=2423.

[22] Defense Acquisition University. *Glossary: Capability development document (CDD).* Retrieved September 13, 2006, from http://akss.dau.mil/jsp/GlossaryAbbreviations.jsp?acronymId=2363.

[23] Defense Acquisition University. *AT&L integrated framework chart: Technology development phase.* Retrieved September 15, 2006, from https://acc.dau.mil/ifc/02_a.htm.

Parameters (KPP) are reviewed. KPPs are those attributes or characteristics of a system that are considered critical or essential to the development of an effective military capability and those attributes that make a significant contribution to the key characteristics as defined in the Joint Operations Concept.[24] KPPs are validated by the JROC for JROC Interest documents. Second, the Information Support Plan (ISP) is developed to explore the information-related needs of an acquisition program in support of the operational and functional capabilities the program either delivers. The ISP provides a mechanism to identify and resolve implementation issues related to an acquisition program's Information Technology (IT), including National Security Systems (NSS), infrastructure support and IT and NSS interface requirements.[25] These documents help facilitate Joint Staff Certification and analysis. For example, J-6 reviews interoperability and supportability; while J-2 analyzes intelligence requirements and viable threats. A key factor is that COCOMs are still present in the capabilities validation/certification process. Service and JROC validation is required for each program certified through the Joint Staff. A System Threat Assessment is performed to validate force protection and survivability issues. All of these certifications and parameters are fed into the finalized CDD, and the KPPs are fed into the acquisitions process. Milestone B approval ends the Technology Development stage. Now, let's review the acquisition life cycle.

C. ACQUISITIONS LIFECYCLE PROCESS

The Acquisitions Cycle process is the event-driven process that oversees the DoD's procurement actions. This process can take years, even decades to complete. It really depends on the size and the scope of the acquisition in question. The average time to reach Milestone B is approximately 2 to 4 years. However, this timeline can expand or contract depending on the program size. The first stage within the process is the pre-concept phase.

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[24] Defense Acquisition University. *Glossary: Key performance parameters (KPP).* Retrieved September 13, 2006, from http://akss.dau.mil/jsp/GlossaryAbbreviations.jsp?acronymId=1173.

[25] Defense Acquisition University. (2004). Defense acquisition guidebook: Information support plan. Retrieved September 3, 2006, from http://akss.dau.mil/dag/DoD5000.asp?view=document&rf=GuideBook\IG_c7.3.6.asp.

1. Flow during Pre-Concept Phase

After the completion of the FSA within the JCIDS process, the event-driven defense acquisition system is initiated. At this point, several things occur simultaneously. These *steps* are indicative of ACAT I programs. ACAT II and III programs have a lower reporting and decision level.[26] First, oversight and review of the program is vetted to the Defense Acquisition review Board (DAB). The DAB advises the Under Secretary of Defense for Acquisition, Technology, and Logistics (USD (AT&L)) on critical acquisition decisions. The USD (AT&L) chairs the DAB, and the Vice Chairman of the Joint Chiefs of Staff serves as the co-chair.[27] Second, a Milestone Decision Authority (MDA) is designated with overall responsibility for a program. The MDA has the authority to approve entry of an acquisition program into the next phase of the acquisition process and is accountable for cost, schedule, and performance reporting to higher authority, including congressional reporting.[28] Any decision made on the program is documented by an Acquisition Decision Memorandum (ADM). It is signed by the MDA and details decisions made as the result of a Milestone Decision Review (MDR) or decision review.

For a major defense acquisition program (ACAT I), an Analysis of Alternatives (AoA) is required at each major milestone. AoAs are an important element of the defense acquisition process. An AoA is an analytical comparison of the operational effectiveness, suitability, and Life-Cycle Cost of alternatives that satisfy established capability needs. Initially, the AoA process typically explores numerous conceptual solutions with the goal of identifying the most promising options, thereby guiding the

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[26] Defense Acquisition University. (2005). *Introduction to defense acquisition management* (7th ed.). Fort Belvoir, VA: Defense Acquisition University Press.

[27] Defense Acquisition University. (2004). *Defense acquisition guidebook: Review procedures.* Retrieved September 3, 2006, from http://akss.dau.mil/dag/DoD5000.asp?view=document&rf=DoD5002/DoD5002-3.10.asp.

[28] Defense Acquisition University. *Glossary: Milestone decision authority (MDA).* Retrieved October 13, 2006, from http://akss.dau.mil/jsp/GlossaryAbbreviations.jsp?acronymId=1282.

Concept Refinement Phase.[29] The Draft AoA plan is developed during the Pre-Concept phase. A complex AoA can take up to two years to complete during this phase.[30]

Other considerations are reviewed and analyzed during the Pre-Concept phase. First, supportability objectives are defined. Pre-acquisition presents the first opportunity to influence supportability and affordability by balancing threats, technology opportunities, and operational requirements. Emphasizing the critical performance-sustainment link, desired capabilities should be defined in terms not only of objective metrics (e.g., speed, lethality), but also of the full range of operational requirements (logistics footprint, supportability criteria) to sustain the mission over the long term. Assessment and demonstration of technology risk includes those related to supportability and to product support. Reliability, reduced logistics footprint, and reduced system life cycle cost are most effectively achieved through inclusion from the very beginning of a program.[31] Also, preliminary integrated architecture is reviewed. This is an architecture consisting of multiple views (operational view, systems view and technical view) that facilitates integration and promotes interoperability across capabilities and among related architectures.[32] Finally, the Program Office Estimate (POE) is completed. The POE is a detailed estimate of acquisition and ownership costs normally required for high-level decisions. The estimate is performed early in the program and serves as the base point for all subsequent tracking and auditing purposes.

Exit Criteria are program specific accomplishments that must be satisfactorily demonstrated before a program can progress further in the current acquisition phase, or transition to the next acquisition phase, or milestone. Exit criteria are normally selected to track progress in important technical, schedule, or management risk areas. They are

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[29] Defense Acquisition University. (2004). *Defense acquisition guidebook: Analysis of alternatives.* Retrieved September 3, 2006, from http://akss.dau.mil/dag/DoD5000.asp?view=document&rf=Guidebook/IG_c3.3.asp.

[30] J.T. Bennet. (2006). Plan in works to overhaul military's embattled acquisition process. *Inside the Air Force,* September 5, 2006.

[31] Defense Acquisition University. (2006). *Defense acquisition guidebook: Pre-acquisition.* Retrieved October 13, 2006, from http://akss.dau.mil/dag/DoD5000.asp?view=document&rf=Guidebook/IG_c5.4.1.asp.

[32] Defense Acquisition University. *Glossary: Integrated architecture.* Retrieved September 13, 2006, from http://akss.dau.mil/jsp/GlossaryAbbreviations.jsp?acronymId=2866.

typically some level of a demonstrated performance outcome (e.g., level of engine thrust), the accomplishment of some process at some level of efficiency (e.g., manufacturing yield), the successful accomplishment of some event (e.g., first flight), or some other criterion (e.g., establishment of a training program or inclusion of a particular clause in the follow-on contract) contract) that indicates that aspect of the program is progressing satisfactorily. Exit criteria serve as gates that, when successfully passed or exited, demonstrate the program is on track to achieve its final program goals and should be allowed to continue with additional activities within an acquisition phase or be considered for continuation into the next acquisition phase. Exit criteria are documented in the Acquisition Decision Memorandum (ADM).[33] An ADM is issued by the MDA to detail exit criteria and complete the Concept Decision Review phase. The MDA is the decision authority for starting the Concept Refinement phase.

2. Flow during Concept Refinement Phase

The Concept Refinement phase represents the first substantial opportunity to influence systems design by balancing technology opportunities, schedule constraints, funding availability, performance parameters, and operational requirements. Desired user capabilities are expressed in terms of Key Performance Parameters and other parameters, and should be defined at this point.[34] This phase refines the initial concept and generates a Technology Development Strategy (TDS). The framework incorporates a Technology Development Phase focused on the development, maturation, and evaluation of the technologies needed for the capability under consideration. Phase activities concentrate on maturing those technologies (consistent with recommended Technology Readiness Levels) and demonstrating readiness to proceed with program initiation. The TDS focuses specifically on the activities of the Technology Development Phase. The TDS details program strategy; cost, schedule, and performance goals; exit criteria for first tech demonstration; and a test plan. It precedes the formal Acquisition Strategy and is

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[33] Defense Acquisition University. *Glossary: Exit criteria.* Retrieved September 13, 2006, from http://akss.dau.mil/jsp/GlossaryAbbreviations.jsp?acronymId=2675.

[34] Defense Acquisition University. (2006). *Defense acquisition guidebook: Alternative system review (ASR).* Retrieved September 3, 2006, from http://akss.dau.mil/dag/DoD5000.asp?view=document&rf=GuideBook\IG_c4.3.1.4.2.asp.

required for Milestone A. The TDS is updated at subsequent milestones and subsumed into the Acquisition Strategy. If the Acquisition Strategy is approved at Milestone A, the TDS may be included in the Acquisition Strategy.[35]

During Concept Refinement, an Initial Technical Review (ITR) is completed. The ITR is a multi-disciplined technical review held early during this phase to support a program s initial Program Objectives Memorandum (POM) submission. The review ensures that a program s technical baseline is sufficiently rigorous to support a valid cost estimate (with acceptable cost risk), and enable an independent assessment of that estimate by cost, technical, and program management subject matter experts.[36]

The output for this review is the Alternative System Review (ASR). The ASR is a multi-disciplined technical review to ensure that the resulting set of requirements agrees with the customers' needs and expectations and the system under review can proceed into Technology Development. The ASR should be complete prior to Milestone A. Generally this review assesses the alternative systems that have been evaluated during the Concept Refinement phase, and ensures that the preferred system alternative is both cost effective and operationally effective. Of critical importance to this review is the understanding of available system concepts to meet the capabilities described in the Initial Capabilities Document. Depending on the overall acquisition strategy, one or more preferred solutions may carry forward into the Technology Development phase.[37] Figure 3 details the ITR/ASR dynamic. Based on the ITR/ASR outputs, as well as the AoA, a Preferred System Concept is selected to meet the capability need of the user.

During this phase, preliminary planning activities are completed. These include preparation of the Acquisition Plan (AP), draft Request for Proposal (RFP), and formal RFP, as well as the Source Selection Proposal (SSP). The AP is a formal written

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[35] Defense Acquisition University. *AT&L integrated framework chart: Concept refinement phase.* Retrieved September 15, 2006, from https://acc.dau.mil/ifc/02_a.htm.

[36] Defense Acquisition University. *Glossary: Initial technical review (ITR).* Retrieved September 19, 2006, from http://akss.dau.mil/jsp/GlossaryAbbreviations.jsp?acronymId=3309.

[37] Defense Acquisition University. (2006). *Defense acquisition guidebook: Alternative system review (ASR).* Retrieved September 3, 2006, from http://akss.dau.mil/dag/DoD5000.asp?view=document&rf=GuideBook\IG_c4.3.1.4.2.asp.

document reflecting the specific actions necessary to execute the approach established in the approved acquisition strategy and guiding contractual implementation.[38] Usually, the SSP consists of two parts: (a) describes the organization and responsibilities of the source selection team; (b) identifies the evaluation criteria and detailed procedures for proposal evaluation. The draft RFP and the final RFP is a solicitation used in negotiated acquisition to communicate government requirements to prospective contractor and to solicit proposals.[39]

As with the Concept Decision Review, the MDA ensures that Concept Refinement Exit Criteria is met. The decision point, Milestone A, determines entry into the Technology Development (TD) phase. The MDA approves the Milestone Decision, and the ADM is created. This ends the Concept Refinement phase. As with any phase, bottlenecks can occur here too.

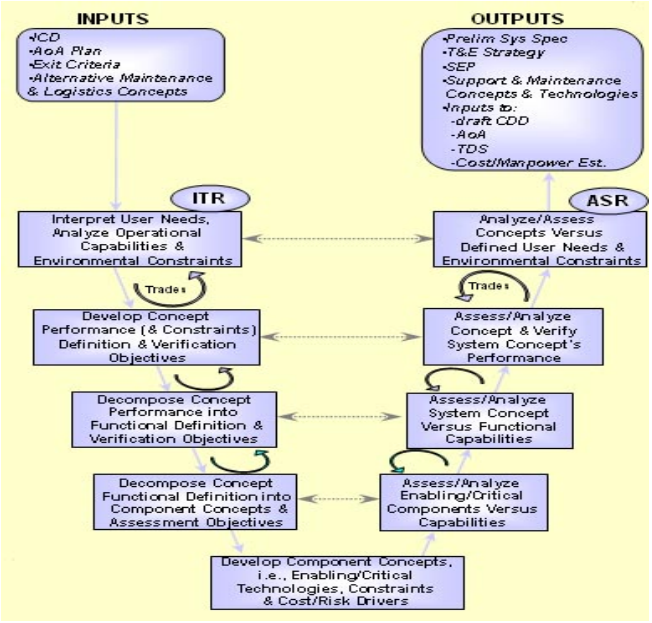

Figure 3. ITR/ASR (From: https://acc.dau.mil/ifc/index.htm. Retrieved September 2006)

[38] Defense Acquisition University. *Glossary: Acquisition plan (AP).* Retrieved September 13, 2006, from http://akss.dau.mil/jsp/GlossaryAbbreviations.jsp?acronymId=2224.

[39] Defense Acquisition University. *Glossary: Request for proposal (RFP).* Retrieved September 13, 2006, from http://akss.dau.mil/jsp/GlossaryAbbreviations.jsp?acronymId=1584.

Taken the PLS example, we can see another bottleneck during the Concept

Refinement stage. After the ICD was finally completed (one year delay), the refined concept required extensive work to make it a reality. Effectively, the refined need required an assembly line modification, a rewrite of Army policy and doctrine, and a new source selection since the original builder couldn't handle the modification.[40] This added an additional 6 years onto the acquisition life cycle. Now, let's analyze the Technology Development phase.

3. Flow during Technology Development Phase

This phase begins the Acquisitions Strategy selection. The Acquisition Strategy defines the approach the program will use to achieve full capability: either evolutionary or single step; it should include a brief rationale to justify the choice. The Acquisition Strategy results from extensive planning and preparation and a thorough understanding of both the specific acquisition program and the general defense acquisition environment. Development of the acquisition strategy requires collaboration between the MDA, PM, and the functional communities engaged in and supporting DoD acquisition. The DoD preference is evolutionary acquisition. When a program uses an evolutionary acquisition strategy, each increment should have a specific set of parameters with thresholds and objectives appropriate to the increment.[41]

The Acquisitions Program Baseline (APB) is developed. Title 10 and DoD Instruction 5000.2 requires every program manager to document program goals prior to program initiation.[42] The APB satisfies this requirement. The PM, in coordination with

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[40] B. Naegle. (9/6/2006). *In-person interview.*

[41] Defense Acquisition University. (2004). *Defense acquisition guidebook: Acquisition approach.* Retrieved October 5, 2006, from http://akss.dau.mil/dag/DoD5000.asp?view=document&rf=Guidebook/IG_c2.3.2.asp.

[42] Defense Acquisition University. (2006). *Defense acquisition guidebook: The acquisition program baseline (APB).* Retrieved September 3, 2006, from http://akss.dau.mil/dag/DoD5000.asp?view=document&rf=GuideBook\IG_c2.1.1.asp.

the user/sponsor, prepares the APB for program initiation. The PM revises the APB for each milestone review, and in the event of program restructurings or unrecoverable program deviations.[43]

Technology demos are scheduled and reviewed. Based upon the results of the verification of components, functionality, and system performance, a System Performance Specification should be created. Trade-offs of achievable performance should be complete and captured in the Systems Specification. Critical and/or enabling technologies should have demonstrated adequate maturity to achieve acceptable levels of risk. The System Performance Specification serves as the guiding technical requirement for the system development effort.[44] Also, the Initial Product Support Strategy is developed. The program manager should develop a product support strategy for life-cycle sustainment and continuous improvement of product affordability, reliability, and supportability, while sustaining readiness. The support strategy is a major part of the Acquisition Strategy. It helps to integrate the support strategy with the systems engineering processes.[45]

A System Requirements Review (SRR) is conducted. The SRR is conducted to determine progress in defining technical requirements. This review decides the direction and progress of the systems engineering effort and the degree of convergence upon a balanced and complete configuration.[46] It is normally held during Technology Development, but may be repeated after the start of System Development and Demonstration to clarify the contractor's understanding of redefined or new user requirements. The SRR (Figure 4) is a multi-disciplined technical review to ensure that

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[43] Defense Acquisition University. (2005). *Defense acquisition guidebook: APB approval.* Retrieved September 3, 2006, from http://akss.dau.mil/dag/DoD5000.asp?view=document&rf=GuideBook\IG_c2.1.1.3.asp.

[44] Defense Acquisition University. (2004). *Defense acquisition guidebook: Demonstrate and validate the system concepts and technology maturity versus defined user needs.* Retrieved September 3, 2006, from http://akss.dau.mil/dag/DoD5000.asp?view=document&rf=GuideBook\IG_c4.3.2.3.9.asp.

[45] Defense Acquisition University. (2004). *Defense acquisition guidebook: Product strategy.* Retrieved September 3, 2006, from http://akss.dau.mil/dag/DoD5000.asp?view=document&rf=Guidebook/IG_c2.3.12.asp.

[46] Defense Acquisition University. *Glossary: System requirements review (SRR).* Retrieved September 13, 2006, from http://akss.dau.mil/jsp/GlossaryAbbreviations.jsp?acronymId=3222.

the system under review can proceed into the System Development and Demonstration phase, and that all system requirements and performance requirements derived from the Initial Capabilities Document or draft Capability Development Document are defined and are consistent with cost (program budget), schedule (program schedule), risk, and other system constraints.

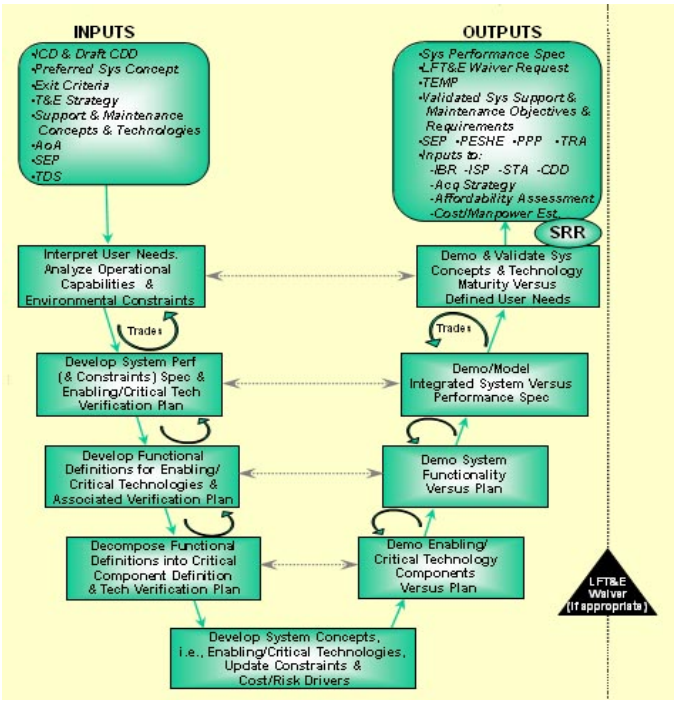

Figure 4. SRR (From: https://acc.dau.mil/ifc/index.htm. Retrieved September 2006)

A series of financial and budgeting reports are performed during this stage. The Cost Analysis Requirements Description (CARD) provides a description of the salient features of the acquisition program and of the system itself.[47] It is the common description of the technical and programmatic features of the program. The CARD is prepared by the lead Component with inputs from participants. The CARD establishes a system description for cost estimating purposes. For joint programs, the CARD must

[47] Defense Acquisition University. *Glossary: Cost analysis requirements description (CARD).* Retrieved October 2, 2006, from http://akss.dau.mil/jsp/GlossaryAbbreviations.jsp?acronymId=2486.

include common salient system features as agreed to by the participants and Component-unique requirements.[48] The CARD is provided to the OSD Cost Analysis Improvement Group (CAIG).

The CARD is used by subsequent cost analysis. The Program Office Estimate (POE) is a detailed estimate of acquisition and ownership costs normally required for high-level decisions. The estimate is performed early in the program and serves as the base point for all subsequent tracking and auditing purposes.[49] The POE leads to the Component Cost Analysis (CCA). The CCA is a cost estimate prepared by an office or other entity of a Military Department that is outside the chain of command of that Military Department's authority responsible for developing or acquiring the program.[50] An Independent Cost Estimate (ICE) is a Life Cycle Cost Estimate (LCCE) for ACAT I programs prepared by an office that is not under the direction or control of the Military Department, Defense Agency, or other Component of the DoD that is directly responsible for carrying out the development or acquisition of the program, or if the decision authority has been delegated to a Component, prepared by an office or other entity that is not directly responsible for carrying on the development or acquisition of the program.[51] All of these cost analysis are used to determine affordability of the system under review.

As with the Concept Refinement stage, exit criteria for the Technology Development stage is determined and the MDA approves the program for advancement. An ADM is issued and the program passes Milestone B, ending this phase. There are delays that can occur during this stage also.

Delays can affect a program within the Technology Development stage. For example, the Army's Family of Medium Tactical Vehicle (FMTV) ran into a series of

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[48] Defense Acquisition University. (2004). *Joint program management handbook* (3rd ed.). Fort Belvoir, VA: Defense Acquisition University Press.

[49] Defense Acquisition University. *Glossary: Program office estimate (POE).* Retrieved September 27, 2006, from http://akss.dau.mil/jsp/GlossaryAbbreviations.jsp?acronymId=1521.

[50] Defense Acquisition University. *Glossary: Component cost analysis (CCA).* Retrieved September 27, 2006, from http://akss.dau.mil/jsp/GlossaryAbbreviations.jsp?acronymId=2407.

[51] Defense Acquisition University. *Glossary: Independent cost estimate (ICE).* Retrieved September 27, 2006, from http://akss.dau.mil/jsp/GlossaryAbbreviations.jsp?acronymId=2820.

delays during this stage. The FMTV was an Army program designed to replace all 2.5 and 5 ton vehicles in the fleet. The requirement was for 80,000 vehicles, and the program totaled $8B. After the Tech Demo and Acq plan update, Congress decided that the plan was too expensive and told the Army to rescope it. This delayed the program by over 3 years. Also, Congress fenced the funding and effectively modified the capability. The Army pressed on with only 60% of the capability met.[52] The rescope wasn't wanted by the Army, and the delay wasn't needed by the user. This is another example of the timeline considerations that arise during the acquisitions process.

4. Timeline Considerations

As stated earlier, the process for reaching Milestone B usually takes 2 to 4 years. However, real-world scenarios have pushed this timeline out further. As you can see by the two real-world examples, the timeline to reach Milestone B can extend to 7, and possibly 10 years, depending on the problems that arise. No program has ever gone through the acquisitions system without some type of delay. A delay can occur at any point and last months or even years. In the meantime, capability to the warfighter is hampered and that could cause a detrimental effect. As you can see by our real-world examples, the delay in the system kept the user from getting the capabilities for over 10 years.

D. SUMMARY

The current acquisitions system (to include JCIDS) hasn't met the critical need of expediting capability to warfighter. With the fast pace of technology, the acquisitions process isn't designed to effectively react to the changing landscape or threat. Currently, there is no bridge between the acquisitions process and the need for rapid technology transference. We believe that a venture capital initiative can fill this stop gap and ensure rapid deployment of technology to the warfighter.

[52] B. Naegle. (9/6/2006). *In-person interview*.

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III. AIR FORCE PROGRAMS

There are several areas of concern with the concept of venture capital being used in the Department of Defense (DoD). This chapter will explore the concerns of statutory authority, congressional aversion to risk, and the potential for conflict with existing programs. Through this exploration, we will show that Congress will provide the necessary statutory authority for an Air Force venture capital initiative and that by providing this authority Congress shows its level of risk acceptance. Once statutory authority and risk aversion are addressed, we will explore the numerous programs in existence for technology transference. By exploring these programs available to Air Force Research Laboratory (AFRL), we looked to find a place where venture capital fit as a potential tool to expeditiously transfer technology from the private sector to the Air Force.

A. STATUTORY AUTHORITY AND RISK AVERSION

To discuss the need for statutory authority it must first be understood that in government funding it is has been affirmed repeatedly that without express authority from congress funding can not be spent. The oft cited reference for this understanding is from the U.S Supreme Court who wrote "The established rule is that the expenditure of public funds is proper only when authorized by Congress, not that public funds may be expended unless prohibited by Congress."[53] So while Congress has provided a specific appropriation for the Air Force to carry out the activity of research and development, it has not stated explicitly that the Air Force can execute a venture capital initiative. Therefore, before any activity is undertaken to put a venture capital program in place, Congress must pass a law providing explicit consent.

Understanding the necessity for explicit statutory authority, we move to the first two areas of concern, statutory authority and risk aversion, which we referenced together because in our opinion they are intertwined. If congress is against venture capital usage based on risk aversion then they would exercise their responsibilities as lawmakers and

[53] U.S v MacCollom 426 U.S.317, 321 (1976).

enact legislation with provisions against venture capital. However, in recent history congress has done just the opposite and enacted legislation for the Department of the Army and Navy to explore venture capital as a means of expeditiously obtaining technologies.

1. 2002 Defense Appropriations Act

In 2002, lawmakers added the Army venture capital initiative to the Defense Department's Appropriation Bill. Lawmakers noted, "The Army's transformation plan is dependent on significant technological advances in weapons, armor, communications and propulsion systems, many of which will originate in the commercial technology development sector."[54] This was recognizing the importance of the commercial sector involvement in executing its internal transformation initiative. One may question why the Army must rely so heavily on the commercial sector for technological needs. The lawmakers stated factually, "Private companies have outspent the federal government in applied research for several years now and are spending a large and growing share of the country's basic research dollars."[55] Since the private sector has the resources in the market, they drive the priorities of that market. Understanding the necessary dependence on the private sector to make the transformation plan work, why not use existing acquisition practices to develop relationships and obtain the technologies needed. Once again we can turn to the lawmakers who observed, "…due in part to the rigidity of traditional contracting mechanisms as well as an acquisition culture that has little concern for the business needs and methods of the commercial world. The Committee sees little hope for the Army to deliver the technological advances it promises without a major change in the way it exploits commercial technology to use the vitality, speed, and intellectual power of the U.S. commercial sector to its maximum advantage."[56] This observation led to the specific statutory authority for the Army to initiate a venture capital initiative, drawing on the CIA's In-Q-Tel venture capital experience, to leverage the private sectors research advantage to obtain technologies needed for their transformation

54 Department of Defense Appropriations Act, 2002, House Report 107-298U.S.C. (2002).

55 Department of Defense Appropriations Act, 2002, House Report 107-298U.S.C. (2002).

56 Department of Defense Appropriations Act, 2002, House Report 107-298U.S.C. (2002).

effort. This shows the statutory authority needed before a venture fund for the Army could be established and the level of risk Congress is willing to accept from a DoD agency.

2. 2003 Defense Appropriation Act

Again in 2003, lawmakers felt venture capital was worthwhile by including in the 2003 Defense Appropriations Act a resolution telling the Navy to explore the feasibility of a venture fund. Lawmakers recognized the inefficiencies in the traditional acquisition process by stating "…Navy's research and acquisition community historically has had great difficulty in transitioning innovative technologies from government research organizations and the commercial marketplace to active development and procurement programs. Due to the constraints of internal planning and budgeting processes, and the stifling legacy of `programs of record', new Navy systems are often fielded with a high degree of technological obsolescence…."[57] Recognizing these process inefficiencies and cultural risk aversion, lawmakers told the Navy to study the CIA's, In-Q-Tel, venture capital initiative success to determine if the Navy could benefit from this type of initiative. Once again this shows the Congress's ability to both accept a level of risk consistent with venture capital funding and therefore provide the needed statutory authority to utilize venture capital as a tool to obtain the needed technologies.

B. POTENTIAL CONFLICT WITH EXISTING PROGRAMS

Now that we discussed the statutory authority and risk aversion concerns, we will look at the numerous programs available to the Air Force in technology transference. Before diving into the programs themselves, we need to provide a definition of technology transference. The Air Force technology transfer handbook defines technology transfer as "process by which existing knowledge, facilities, or capabilities developed under federal research and development (R&D) funding are utilized to fulfill public and private needs."[58] This definition leaves the impression that DoD performed the research and development effort and is now looking for ways to capitalize on those

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57 Department of Defense Appropriation Act, 2003, House Report 107-532U.S.C. (2003).

58 AFRL. (1/17/2002). Air force technology transfer handbook. Retrieved August 1, 2006 from http://www.dtic.mil/techtransit/.

efforts. We are looking for a way to move technology developed in the private sector to the field. Moving past the laboratories and actually have a working product to fulfill a need. Bernard Chachula wrote in his evaluation of an Air Force venture capital initiative that we are striving for "technology transition" which he defined as moving the technology from the lab to the program office and finally to the operational unit in the field.[59] This is important because in order to work effectively with the private sector we must be able to communicate with each other and this definition provides a parallel to private sector actions of moving from technology to a product and finally into the marketplace. Therefore, we define the need for technology transfer as Chachula did with technology transition. This relationship is depicted in Figure 5.

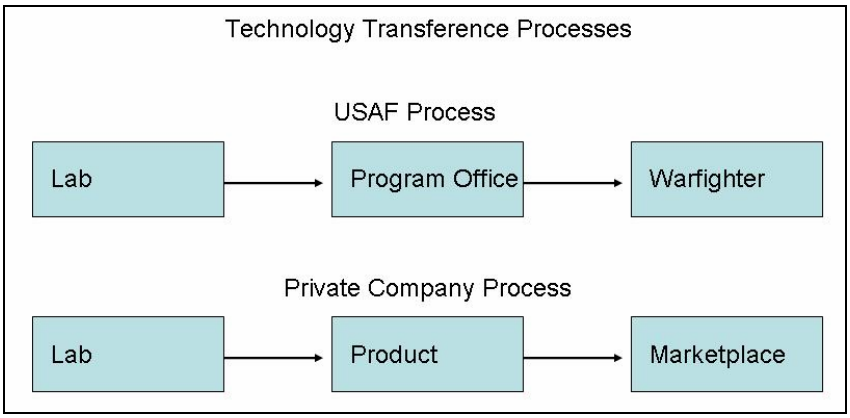

Figure 5. Technology Transference Processes

The Air Force department responsible for developing the technology of tomorrow is the AFRL. Its stated mission is "Leading the discovery, development, and integration of affordable warfighting technologies for our air and space force".[60] In the course of accomplishing these activities it has several arrangements with private sector partners. These arrangements are contractual agreements as to who will do which actions and with what resources. These agreements include the following:

59 B.M. Chachula. (2004). Evaluate initiation of an air force venture capital fund No. WBI-2004-1). Ohio: Wright Brothers Institute.

60 AFRL. (May 23, 2006). AFRL mission and vision. Retrieved August 10, 2006 from http://www.afrl.af.mil/vision.asp.

- Cooperative Research and Development Agreements (CRADA)
- Cooperative Agreements (CA)
- Education Partnering Agreements (EPA)
- Partnership Intermediary Agreements (PIA)
- Technology Investment Agreements (TIA)

All of these agreements are provided for in law and have limitations concerning their use.

1. Cooperative Research and Development Agreements (CRADA)

A CRADA is a written agreement between a private company and a government agency to work together on a project. They allow the Federal government and non-Federal partners to optimize their resources, share technical expertise in a protected environment, share intellectual property emerging from the effort, and speed the commercialization of federally developed technology.[61] A point we would like to stress in this definition is that the technology is not provided to the Air Force, but instead is provided to the private company to turn into a product for the marketplace. CRADAs are authorized under United States Code (USC) Title 15 Commerce and Trade Chapter 63 Technology Innovation Section 3701. The procedures for using CRADAs can be found in Air Force Instruction (AFI) 61-302 Cooperative Research and Development Agreements. While we are not concerned with the procedures for establishing a CRADA we are concerned with what can and can not be done under a CRADA. Table 1 identifies what resources can be expended under a CRADA from both parties involved in the agreement.

61 US Department of the Interior. (August 15, 2006). Cooperative research and development agreements. Retrieved August 21, 2006 from http://www.usgs.gov/tech-transfer/what-crada.html.

Table 1. CRADA

From the Air Force:	**From the CRADA partner:**
Personnel	Personnel
Personal Property	Personal Property
Facilities	Facilities
Services	Services
Intellectual Property	Intellectual Property
	Funds

As you can see in Table 1, the Air Force does not provide funding under a CRADA and there in lies the problem. While these agreements are wonderful at creating products for public or defense use, we are looking to fund cutting edge ideas that we have not found yet. The fact that we provide the technology is the limitation of the CRADA when compared to an Air Force Venture Capital initiative. In addition to a CRADA, AFRL can use CAs to accomplish technology transfer.

2. Education Partnering Agreement (EPA)

An EPA is a legal agreement between the Air Force and an educational institution. EPAs are authorized under Title 10 USC Section 2194 and the AFI 61-301 outlines what is provided to each party. Under the law the Air Force may provide excess defense laboratory equipment, laboratory personnel to teach science courses or assist in the development of science courses, cooperate with the institution in developing a program under which students may be given credit for work on defense related projects, and provide academic and career advice to students[62]. While EPAs provide the Air Force with the ability to influence basic research and development efforts, they are not focused on providing technologies to the warfighter today. This is the primary focus of our proposed venture capital initiative. Similar to an EPA is the PIA.

62 USAF, AFI 61-301 The Domestic Technology Transfer Process and the Offices of Research and Technology Applications, (2001).

3. Partnership Intermediary Agreement (PIA)

A PIA is an agreement that provides for a partnership intermediary to perform services for the Federal laboratory that increase the likelihood of success in the conduct of cooperative or joint activities of a federal laboratory with small business firms and institutions of higher education.[63] The partnership intermediary as found in 15 USC Section 3715 must be an agency of a state or local government or a nonprofit entity that is owned, funded, or operated by a state and local government that interacts with small businesses or institutions of higher learning.[64] The purpose of the agreement is to transfer technology created in a federal laboratory to a small business that can make use of that assistance. Like the agreements listed above the PIA has the technology flowing from the federal government to a private institution, although in this case it is through an intermediary, for the purpose of bringing a new product to the marketplace. The final agreement we will discuss here is the TIA.

4. Technology Investment Agreement (TIA)

The TIA was Congress's push to involve private for-profit companies that typically did not do business with the government in research and development efforts. The ultimate goal of a TIA is to foster the best technologies for future defense needs.[65] Under a TIA the Air Force could fund research with the intent of developing a technology for the commercial and defense marketplace. So far the agreement sounds a lot like a venture capital initiative. There are a couple of problems thought. First, priority is given to consortium efforts. This means that companies without other for-profit partners may not receive funding due to their concerns over intellectual property rights. Second, there is a requirement of cost sharing. The cost sharing policy has an expectation of 50%. While this shows the commitment of the company towards the technology/product, it limits the ability of possible participation by firms without the

63 15 USC. 3715 Use of Partnership Intermediaries, (2005), Retrieved September 5, 2006, from http://uscode.house.gov/search/criteria.shtml.

64 15 USC. 3715 Use of Partnership Intermediaries, (2005), Retrieved September 5, 2006, from http://uscode.house.gov/search/criteria.shtml.

65 DoD, DoD 3210.6-R DoD Grant and Agreement Regulations, Part 37 Technology Investment Agreements, (2003).

ability to fund their own operations. The point of venture capital is to fund those firms that can not obtain funding through traditional channels (i.e. banks) and would therefore would not be in business.

5. Small Business Innovation Research (SBIR)

In addition to the agreements listed above AFRL also administers a grant-type program known as Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR). As the name implies the SBIR program is designed to stimulate research initiatives by small businesses while providing the government with cost-effective technical and scientific solutions[66]. Similar to venture capital funding cycles, SBIR is a three step process. During the phase one the feasibility of the technology is determined and contracts valued up to $100,000 are issued. Phase one lasts from six to nine months. Phase two starts following the successful completion of phase one. During phase two the research and development effort is carried out to produce a well defined product or process. Contracts for phase two are typically two years in length and are valued up to $750,000. Phase three is the commercialization of the developed technology. This is where SBIR stops. The small business must find alternative sources of funding for this stage either from the private sector or through a federal (Non-SBIR) source.[67] While SBIR does focus on small businesses, like venture capital, the big difference is the amount of funding provided to develop an idea for a technology into an actual product. As you will see in the next section, $850,000 dollars does not even begin to provide the funding necessary to provide a successful technology in most industries.

C. SUMMARY

We believe that venture capital is a tool the Air Force can use to transfer technologies it needs to fulfill the requirements of the warfighter. We know that Congress has accepted the level of risk necessary to operate a venture capital fund through its legislation authorizing and appropriating funds for multiple federal agencies, including the Army, to initiate their own venture capital fund. Through this risk

66 AFRL. (2006). Air force small business innovation research. Retrieved August 12, 2006 from http://www.afrl.af.mil/factsht/sbirfactsheet.asp.

67 AFRL. (2006). Air force small business innovation research. Retrieved August 12, 2006 from http://www.afrl.af.mil/factsht/sbirfactsheet.asp.

acceptance we believe Congress would provide the same statutory authority to the Air Force. We also believe that while programs currently do exist to stimulate research and development efforts, venture capital does fit as another tool, which is necessary to meet the ever changing demands of the market place.

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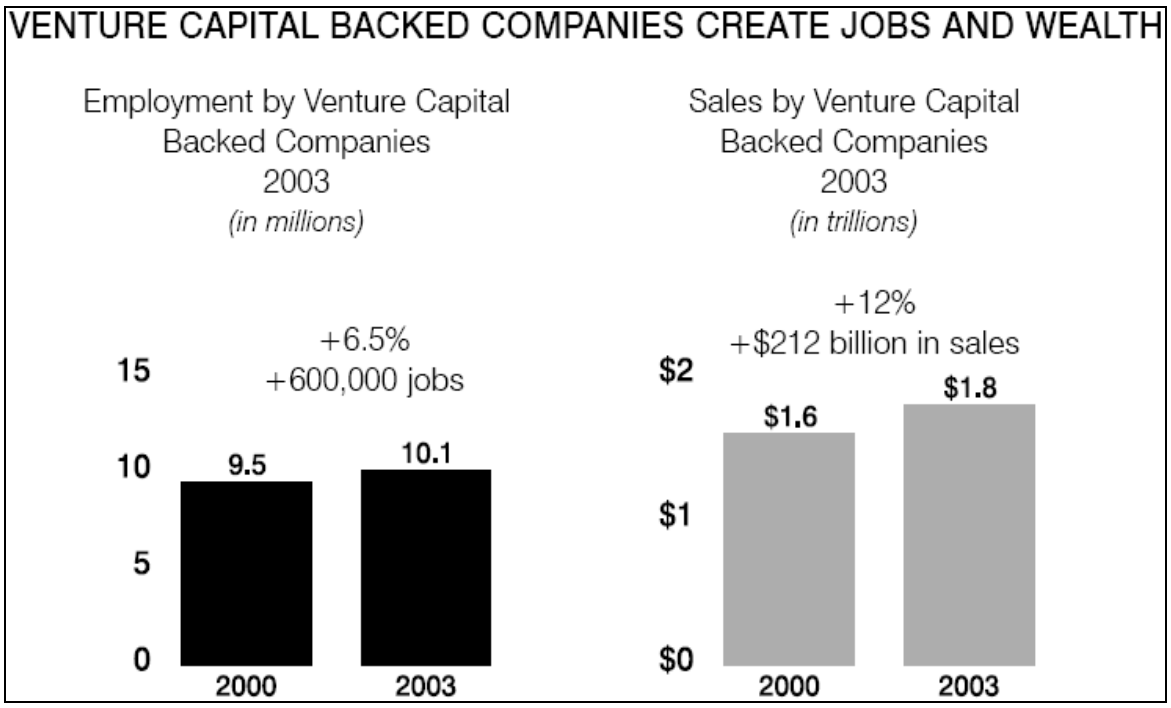
IV. ROLE OF VENTURE CAPITAL

Traditionally, venture capital (VC) focuses on funding companies that do not have the size and assets necessary to acquire capital from public markets and banks. The VC industry channels this needed funding to the new or growing companies which represent a good prospect for future success.

Table 2. VC Job and Wealth Creation (From: Venture Impact 2004)



As we can see from the illustration above VC-backed companies are an enormous source for jobs and inject trillions of dollars into the economy each year.. Subsequently, the use of VC in the United States Air Force (USAF) falls directly in line with Congressional goals of job creation through government programs.

In an article published from the Air Force's Outreach Program Office, President Bush is quoted as saying "small businesses create most new jobs in our country, and small businesses have been a driving force behind America's tremendous economic

growth and job creation."[68] Using VC, through the VAPR program, allows the Air Force to meet its goals of technology transference and the President's goals of job creation and economic growth.

Additionally, Mr. Diamond from the Outreach Program Office was quoted as saying "America's small businesses deliver support to the war fighter at every turn, whether we are talking about major weapons systems or parts of pieces of major systems, or subsystems that are supporting and rendering our Air Force capability as the best in the world."[69] Whether it is a guard at the gate of an Air Force installation, or one of the numerous contracted support functions, small business is an integral part of the Air Force structure. Bolstering that support structure with VC-backed companies only stands to benefit the Air Force even more.

In conjunction with providing investment funding to new companies VC firms can provide incubator funds for these companies as well. In fact, the incubator funding model possesses great potential for the Air Force in how it can benefit from VC.

Incubators provide a combination of financial, legal, management and other types of support to start-ups. Incubators allow new/growing companies to take advantage of economies of scale, skills, experience and in some cases capital that might otherwise be lacking or out of reach in financial terms. Additionally, incubators significantly cut down on start-up's overhead. The incubator recently set up by the internet firm, Lycos, for example, offers finance, office space and technical support to all its sponsored start-ups.

The efficacy of incubators can most clearly be seen through a comparison of the traditional start-up model with the new incubator-based model. While the old-style start-up might take four to seven years (or even more) to become "market ready," the incubator approach can produce the same effect in between two and five years.[70] This

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[68] M. Cenkci. (April 12, 2006). Small business integral part of air force operations. *Air Force Link*, p. 1.

[69] M. Cenkci. (April 12, 2006). Small business integral part of air force operations. *Air Force Link*, p. 1.

[70] P. Burgess. (2002). *The role of the venture capital provider*. Retrieved September 28, 2006, from http://www.altassets.net/knowledgebank/learningcurve/2002/nz3275.php.

reduction in the acquisition timeline becomes especially appealing to the United States Air Force (USAF) for its ability to rapidly transfer needed technologies to the war fighter.

A. VC FIT IN THE DOD ARENA

Whether it is through incubators or business angels, the role of venture capital for the USAF must support rapid transference of technology while meeting capability requirements of the war fighter.

1. Technology Transference

Perhaps the most appealing aspect of VC to the DoD is its ability to rapidly transfer technology. As we have seen from the discussion of acquisition timelines in section two, perhaps the largest roadblock to the transference of technologies is how long the current acquisition process takes. As programs stretch on over longer periods of time requirements creep occurs and costs tend to increase significantly.

While venture capital does not always guarantee success[71] it has demonstrated in recent years to rapidly transfer technologies while meeting strong ROIs. Conceivably the best example of venture capital at work for the DoD is the CIA's program In-Q-Tel. In-Q-Tel has served as the non-profit, venture capital arm of the CIA for the past five years.

Each year the CIA funds In-Q-Tel with approximately 37 million dollars. To date, the CIA has invested in over 75 companies which have delivered more than 100 technologies.[72] This average of 20 technologies transferred each year is what has become so appealing about VC. Yet what about the myriad technologies gained by the USAF each year under the current acquisition process.

Currently, the problems with the traditional acquisition system are program overruns coupled with time delays. While multiple technologies are transferred under the current acquisition process each year they are from programs that took five to seven years

[71] L. Himelstein, P. Burrows, & A. Reinhardy. (1997). *The great hunt for hot ideas.* Retrieved September 21, 2006, from http://www.businessweek.com/1997/34/b354140.htm.

[72] T. O'Hara. (2005). *In-Q-tel, CIA venture arm, invest in secrets.* Retrieved August 16, 2006, from www.WashingtonPost.com.

(or more) to complete and cost much more than originally planned. So, by the time the technology is finally acquired by the USAF its cost was so high one wonders if it was worth it, or is already outdated by current technology.

Venture capital, through the CIA's In-Q-Tel program, has shown it can rapidly transfer technologies to the investor(s) with great returns on the investment. Over the past five years the CIA has managed to not only acquire over 100 technologies, but obtain an internal rate of return of 26%. These numbers clearly indicate a need to include a VC arm in the USAF's acquisition process.

2. Meet Capability Requirements

The role of the VAPR program is to satisfy capability requirements of the war fighter. Currently, the USAF is attempting to move away from individualized program budgeting to capabilities-based budgeting. To do this they have integrated the budgeting process with the AF corporate structure. This created a deliberate, cross-functional flow of information allowing senior leadership to rack and stack needs. Unfortunately, the full paradigm shift has yet to occur and as the integrated process teams move through the levels of leadership they still look at individual programs to fund versus capability.

The VAPR program allows for the full paradigm shift to capabilities-based budgeting because it is not part of the current bureaucratic budgeting environment. Like the In-Q-Tel program, VAPR will receive its own budget along with a requirements list from the USAF. These requirements for technology and subsequent capabilities come directly from the COCOMs and MAJCOMs. Using this approach allows the VAPR program to immediately probe the market for investment opportunities.

B. VC CATEGORIES

Although the Air Force as a whole could benefit from VC in almost all Venture Economics Industry Classification (VEICs) this program focuses on the rapid transference of technology for the war fighter in 38 categories. The following list has been created obtaining technologies that best support the COCOMs:

Table 3. USAF VAPR Program VEICS

USAF VAPR Program VEICs								
Rank	VEIC	Nomenclature	Size ($M)		Rank	VEIC	Nomenclature	Size ($M)
1	9180	Advanced Aircraft/Aerospace	8.595		20	1630	Microwave Service Facilities	0.000
2	1810	Defense Communications	1.269		21	1640	Microwave & Satellite Components	20.130
3	3810	Military Electronics (excluding communications)	0.030		22	1699	Other Satellite & Microwave	1.470
4	4400	Biosensors	0.015		23	1500	Data Communications	6.153
5	4490	Other Biosensors	8.166		24	1399	Other Wireless Communications	13.875
6	1300	Wireless Communications	12.981		25	9160	Airfield & Other Transportation Services	1.782
7	3200	Batteries	8.583		26	2130	Optical Computing	10.479
8	3135	Sensors	13.209		27	2911	Voice Recognition	11.940
9	3139	Other Controllers/Sensors	16.017		28	2910	Voice Synthesis	5.472
10	2716	Graphics & Digital Imaging S/W	5.940		29	2739	ERP/Inventory/Software	10.104
11	2200	Computer Graphics & Digital Imaging	7.410		30	3100	Semiconductors-Electronic Components	4.920
12	2295	Digital Imaging Services	9.129		31	3110	Semiconductors	12.135
13	2290	Digital Imaging H/W & Equipment	7.461		32	3510	Laser Components (incl. beamsplitters, excimers)	24.081
14	2236	OBR (Optical Bar Recognition)	0.300		33	2125	Portable Computer (notebooks/laptops)	1.200
15	2234	OCR (Optical Character Recognition)	1.752		34	2122	Mini Computers	0.000
16	2238	MICR (Magnetic Ink Character Recognition)	0.006		35	3160	Display Panels	5.580
17	1620	Satellite Ground (& other) Equipment	4.860		36	1310	Mobile Comm., Pagers & Cell Radio	10.062
18	1610	Satellite Services/Carriers/Operators	13.902		37	1510	LANs (incl. voice/data PBX systems)	15.045
19	1600	Satellite Microwave Comm	0.540		38	1515	Wide Area Networks	14.823

Each of the above categories carries with it an optimum size (in Millions) which is needed to be competitive in its respective VC sector. The "Size of Fund Necessary to be Competitive" section below statistically breaks out this optimal size fund for each of the VEICs in the above table.

When compared to the hypothetical funding level of $50M for the VAPR program, approximately 10 VEICs can be utilized. This number is based on an average VEIC funding requirement of $5.08M[73]. Since not all VEICs can be funded at any one time (without an extremely large budget) the VEICs have been put into a prioritized order as seen in the table above. The ranking of VEICs allows senior leadership to recognize which areas most require the funding based on limited resources. In addition to ranking the VEICs, a funding policy must be created to account for possible distribution scenarios of program funds. Two scenarios have been created and are captured in the next section.

C. SIZE OF FUND NECESSARY TO BE COMPETITIVE

Certain levels of funding, on average, are required to be competitive in the VC sectors listed in Table 3. Competitiveness is defined as the ability to successfully transfer a technology and achieve the desired ROI for the investment through assertion of

[73] $5.08 avg. funding per VEIC based on adding up the average cost per deal (over 5-year period) for each VEIC and dividing by 38 (total number of VEICs).

influence on the market. In order to assert influence on the market the total fund size must be representative of what VC firms currently invest in the respective VEIC sectors to acquire technologies and their respective ROIs. We use this as the level required to assert influence based on the assumption VC firms would not invest without the real probability of achieving a desired ROI.

Regression analysis was used to determine if there is an appropriate level of funding required to achieve competitiveness within the market. Each of the 38 VEIC codes listed in table 3 were analyzed separately to determine optimal size funds for the VAPR program to fund individually. However, analyzing data for the 38 VEICs (table 3) over a five year period revealed there is no correlation between the amount of money invested per deal, the VEIC it was spent on, or the year in which it was spent. This conclusion was derived from regression analysis conducted on the average amount invested per deal per VEIC and the average amount invested per deal for all VEICs combined over a five year period. The ANOVA tables below summarize the regression analyses. Table 4 contains an example of an analysis of just one VEIC and Table 5 summarizes the average deal per year.

Table 4. One VEIC Regression Analysis Example

SUMMARY OUTPUT: VEIC 1300

Regression Statistics	
Multiple R	0.397554517
R Square	0.158049594
Adjusted R Square	-0.122600542
Standard Error	5.975333742
Observations	5

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	20.10724	20.10724	0.563155237	0.507486974
Residual	3	107.11384	35.70461333		
Total	4	127.22108			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 90.0%*	*Upper 90.0%*
Intercept	-2830.572	3784.802524	-0.747878385	0.508821551	-14875.50281	9214.358807	-11737.58787	6076.443867
Year	1.418	1.889566441	0.750436698	0.507486974	-4.595443737	7.431443737	-3.028836568	5.864836568

Table 5. Average VEIC Regression Analysis Example

SUMMARY OUTPUT: Average Deal Per Year (all VEICs)

Regression Statistics	
Multiple R	0.285118506
R Square	0.081292562
Adjusted R Square	-0.22494325
Standard Error	1.600474704
Observations	5

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.679974245	0.679974245	0.265457399	0.64195616
Residual	3	7.684557832	2.561519277		
Total	4	8.364532078			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 90.0%*	*Upper 90.0%*
Intercept	527.3860789	1013.747677	0.520234069	0.638853583	-2698.811469	3753.583626	-1858.330635	2913.102793
X Variable 1	-0.260763158	0.50611454	-0.515225581	0.64195616	-1.871445506	1.34991919	-1.45183461	0.930308295

Based on the poor f-statistics in the ANOVA tables above we would not accept any of the equations created by the analyses. Therefore, we must conclude the mean is a better predictor of the cost per investment, or deal. Additionally, to create the optimal fund size we must consider how many failures VC firms observe before reaping the benefits of a successful investment. In an article by Business Week[74] approximately one out of every three ventures fails. For this reason the optimal size funds listed in table 3 are based on the average amount invested per deal for each VEIC over a five year period multiplied by the number of investments required to get a one successful venture. Therefore, the optimal size funds that are listed in Table 3 are for acquiring *one* technology.

It is important to note some VEICs have zero for their suggested fund size. This is directly due to no investments made in those sectors for the past five years. This lack of interest could be for many reasons. Since VC typically is associated with new starts and out-of-the box products/services, these VEICs may not currently have anything new to bring to the market. It could also be that no VC firms are looking for technologies in these areas. Or, the lack of investment could be a result of projects that are unable to

[74] L. Himelstein, P. Burrows, & A. Reinhardy. (1997). *The great hunt for hot ideas.* Retrieved September 21, 2006, from http://www.businessweek.com/1997/34/b354140.htm.

meet VC ROI requirements and are subsequently not worthy of VC support. The VAPR program should be careful when approaching these sectors to ensure technologies are invested in that can return a sufficient ROI.

Now that the optimal fund sizes have been analyzed and created the VAPR program must be set up to tackle typical funding constraints. Since it is unlikely the VAPR program will only be interested in acquiring technology from one sector this paper analyzes and creates the optimal (on average) size fund needed by the VAPR program to utilize ten VEICs and five VEICs (called VAPR-LITE) respectively. Additionally, knowing that the world of budgeting will most likely provide less than the optimal funding required to fully fund these scenarios a funding system must be created to maximize the technologies transferred.

Two approaches are available when distributing funding across VEICs; the full funding approach and the weighted approach. The full funding approach, as its name suggests, completely funds each VEIC in the VAPR program. This is done in accordance to the ranking of the VEICs. Tables 6 and 7 below, for the 5-VEIC and 10-VEIC programs respectively, represent the funding requirements to achieve the transference of one technology per VEIC:

Table 6. Funding Distribution Scenario (5 VEICs)

Funding Distribution Scenario 1, 5-VEICs			
Rank	**VEIC**	**Nomenclature**	**Size ($M)**
1	9180	Advanced Aircraft/Aerospace	8.595
2	1810	Defense Communications	1.269
3	3810	Military Electronics (excluding communications)	0.03
4	4400	Biosensors	0.015
5	4490	Other Biosensors	8.166
		TOTAL FUNDING REQUIREMENT:	**18.075**

Table 7. Funding Distribution Scenario (10 VEICs)

Funding Distribution Scenario 2, 10-VEICs			
Rank	**VEIC**	**Nomenclature**	**Size ($M)**
1	9180	Advanced Aircraft/Aerospace	8.595
2	1810	Defense Communications	1.269
3	3810	Military Electronics (excluding communications)	0.03
4	4400	Biosensors	0.015
5	4490	Other Biosensors	8.166
6	1300	Wireless Communications	12.981
7	3200	Batteries	8.583
8	3135	Sensors	13.209
9	3139	Other Controllers/Sensors	16.017
10	2716	Graphics & Digital Imaging S/W	5.94
		TOTAL FUNDING REQUIREMENT:	**74.805**

As we can see in the preceding tables the full funding policy for the 5-VEIC program, VAPR-LITE, requires $18.075M for its budget. Likewise, to fully fund the 10-VEIC program requires $74.805M.

Table 8, below, is an example of the full funding policy for the VAPR program (10 VEICs) receiving $50M for its budget. This scenario takes into account that the goal of the VAPR program is to fund 10 VEICs thus acquiring 10 technologies:

Table 8. Full Funding Example

VAPR Full Funding Example			
Rank	**VEIC**	**Nomenclature**	**Size ($M)**
1	9180	Advanced Aircraft/Aerospace	8.595
2	1810	Defense Communications	1.269
3	3810	Military Electronics (excluding communications)	0.03
4	4400	Biosensors	0.015
5	4490	Other Biosensors	8.166
6	1300	Wireless Communications	12.981
7	3200	Batteries	8.583
10	2716	Graphics & Digital Imaging S/W	5.94
14	2236	OBR (Optical Bar Recognition)	0.300
15	2234	OCR (Optical Character Recognition)	1.752
		TOTAL FUNDING REQUIREMENT:	**47.631**
		Unused Funds	**2.369**

As we can see from Table 7, using the full funding policy for the top 10 VIECs requires, on average, $74.805M. Therefore, a budget of $50M requires the program to

drop some of its top ten in lieu of cheaper alternatives down the list. Table 8 illustrates how the program dropped the VEICs rank eight and nine and replaces them with 14 and 15 respectively.

The example above illustrates how funding will always leave unused funds in the budget unless the top ten are funded to requirement. This left over funding leaves us with three options; 1) give the remaining money back, 2) make multiple investments in VEICs (in the top 10) inexpensive enough to allow it (e.g., invest more than once in VEIC 3810, Military Electronics), or 3) create a weighting system for the top 10 VEICs to allow for complete apportionment of the budget.

While numbers one and two are viable options, creating a weighting system brings about two related areas of concern. First, why would we *not* fully fund the optimal size of the VEIC if the optimal size is needed to be competitive and acquire the technology? This becomes an important issue because if one chooses to fund ten VEICs with $50M when it requires $55M, the weighted factors, by nature, creates less than optimal funding patterns in *each* VEIC. This directly relates to the second issue.

Does competitiveness equate to transference of technology? In other words, is competitiveness proportional to the dollars invested? Earlier in this section we made the argument that to be competitive (have the ability to assert influence) we must fund each VEIC to the five-year average of what is invested by the market. If we choose to fund only 90% of the optimal fund size do we get 90% of what we're looking for, or is it actually less than that? While creating a weighting system for the VEICs allows for full allocation of funds we conclude the lack of optimal funding affects competitiveness and the ability to influence the market and the technology the USAF is trying to acquire. Thus it is not appropriate for use in the VAPR program.

D. SUMMARY

Venture capital and its ability to find emerging technologies and quickly bring them to the market has a lot of potential for the Air Force. Section two of this paper pointed out how long it takes the current acquisition process to produce a usable technology. With such long lead times the technology is often outdated by the time of its

roll-out to the warfighter. We argued in this section that the possibility for hastening technology transference lies not just with VC itself but with the use of incubator style VC funding. These incubators produced usable technologies in as little as two to four years vice the four to seven with out them.

However the Air Force chooses to fund its investments it must ensure it can be competitive in the market. Competitiveness is the VAPR program's ability to successfully transfer a technology and achieve the desired ROI for the investment through assertion of influence on the market. We showed, through analysis, the average amount needed to be competitive in the venture capital markets was, in most cases, significantly higher than amounts authorized in the different phases of the SBIR program[75] and other AF investment arrangements. With higher than normal investment amounts the Air Force must decide how many technologies it wants to acquire each year and budget accordingly. The VAPR (ten-technology) and VAPR-LITE (five technologies) programs each require different budgets relative to the full funding policy and number of technologies invested in. While this leads to the discussion of what the VAPR program will look like programmatically, it also eludes to other issues such as self-sustainability, program profitability, AF use of the program, requirement sets, etc. We discuss these areas and more in the next section as we break out the VAPR program model in detail.

[75] See section III of this paper for SBIR amounts per phase.

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V. USAF VC APPLIED PROCUREMENT RESPONSE (VAPR)

Chapters II through IV discussed the acquisitions timeline, various secondary AF acquisition programs and the role of a VC initiative within the AF respectively. With the role and fit of a VC initiative described it now becomes important to detail the actual program that is the VAPR SPO. This chapter addresses the VAPR model in detail to include the VAPR mission, requirements generation process, process flow, program oversight, SPO/contractor coordination, for-profit versus not-for-profit, program funding and two measures of success.

A. VAPR MISSION

The purpose of the VAPR program is to support the Air Force's mission of delivering sovereign options for the defense of the United States of America[76]. In order to execute the mission of the Air Force we must be able to rapidly equip the warfighter with technologies capable of combating emerging global threats. Subsequently, the VAPR program must support the acquisition process and Secretary of Defense Donald Rumsfeld's transformation guidance.

The VAPR program supports the acquisition and transformation processes through its ability to rapidly transfer technologies. Additionally, VC, by its very nature, follows the SECDEF's guidance of creating a culture that is creative and takes prudent risks. Using VC allows the USAF to proactively vice reactively pursue emerging technologies. It allows the firms more familiar with their immediate markets to pursue the technologies instead of federal employees with limited market background.

Although the main focus of the VAPR program is to rapidly transfer technologies to the USAF, a secondary benefit of job creation occurs from which the economy naturally benefits. This paper will address this side-affect due to using a VC-based program, but only in part.

[76] United States Air Force. *Air force mission.* Retrieved October 17, 2006, from http://www.af.mil/main/welcome.asp.

1. Technology Transference

Before we begin to discuss the VAPR program's goal of technology transference we need to readdress the definition created in Chapter III of this paper. First, the Air Force technology transfer handbook defines technology transference as the "process by which existing knowledge, facilities, or capabilities developed under federal research and development (R&D) funding are utilized to fulfill public and private needs."[77] This definition creates the impression that DoD performed the R&D and is now looking for ways to capitalize on those efforts.

Our goal with the VAPR program is to move technology developed in the private sector to the field moving past the laboratories and actually have a working product to fulfill a need. Bernard Chachula wrote in his evaluation of an Air Force venture capital initiative that we are striving for "technology transition" which he defined as moving the technology from the lab to the program office and finally to the operational unit in the field.[78] This is important because in order to work effectively with the private sector we must be able to communicate with each other and this definition provides a parallel to private sector actions of moving from technology to a product and finally into the marketplace. Therefore, we define the need for technology transfer as Chachula did with technology transition. This relationship is depicted in Figure 6.

[77] AFRL. (1/17/2002). Air force technology transfer handbook. Retrieved August 1, 2006 from http://www.dtic.mil/techtransit/.

[78] B.M. Chachula. (2004). *Evaluate initiation of an air force venture capital fund* No. WBI-2004-1). Ohio: Wright Brothers Institute.

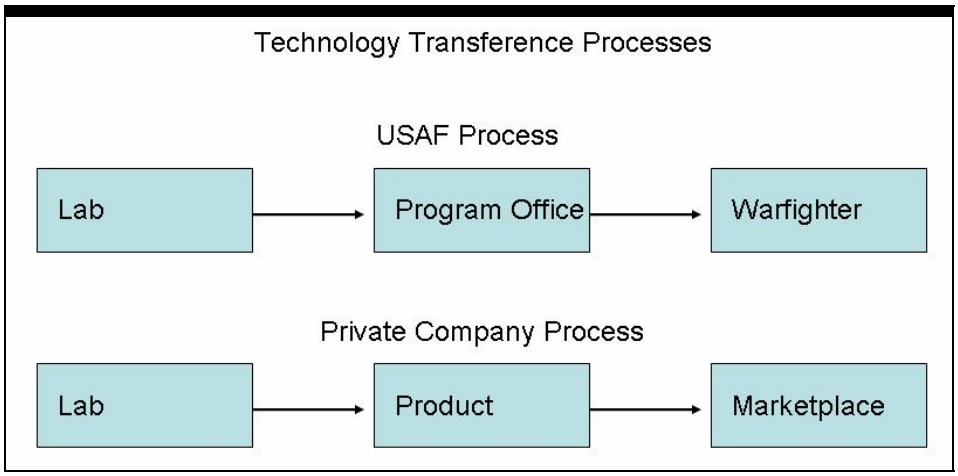


Figure 6. USAF Technology Transference Process

2. Job Creation (Secondary Benefit)

While technology transference is the primary goal of the VAPR program, VC programs inevitably create jobs through their funding and support. Job creation, by means of a USAF VC program, expands the industrial base used by the USAF creating many benefits from which to draw upon:

- Allows small companies to bring technologies to the USAF that might otherwise be overlooked
- VC is a way of courting new contractors into business with the government
- Decreases reliance on small number of large contactor as only source of technologies
- Helps the USAF meet small business contracting goals/requirements
- Exponential increase in technology increase in the industry

Additionally, creating/adding companies to the industrial base through a VC program helps to alleviate current perceptions of doing business with the DoD. Since perception is often reality it becomes important to find a way to reframe how the market thinks about doing business with the government.

A survey conducted by the school of public policy at the University of Baltimore (2003) researched the IT industry's attitude on doing business with the DoD. The current, common perceptions from the 400 vendors and non-vendors are; 1) DoD doesn't know what they want (constantly changing requirements), 2) the application/bid process is too long and confusing, 3) DoD only wants to deal with large companies, 4) our products are not needed by the DoD, 5) we do not want work with the DoD and 6) there are too many barriers to the bid process.[79]

Removing the perceptions above greatly benefits the USAF and increases its ability to find needed technologies to support the warfighter. Additionally, as the USAF transitions to capabilities-based programming it needs to be able to identify and exploit new technologies. The following section discusses how the VAPR program provides a method for identifying and filling capability shortfalls.

B. REQUIREMENTS GENERATION PROCESS

The importance of the requirements generation process and supporting activities can not be understated. With the transformational shift happening within the DoD, it is clear that efficiency in generating requirements is critical. The VAPR Program serves as a supplement to the acquisitions lifecycle and overarching JCIDS structure through its ability to rapidly identify critical capabilities. It does not replace the existing requirements, nor does it add any steps to the existing acquisitions structure. Due to the existing size, requirements generation, oversight, and control mechanisms for large ACAT I and II programs, the VAPR program is tailored to fit the generation process for ACAT III needs. However, it serves as a reach back for incorporating technologies for these larger systems. The critical aspect of VAPR is the adaptability to Air Force needs.

Instead of adding another layer to the capabilities identification process, the VAPR program provides an avenue to expedite existing technologies, explore less

[79] University of Baltimore, Schaefer Center for Public Policy. (2003). *Survey of information technology firms*.

traditional technological sources, and leverage emerging technologies into the hands of the warfighter. As such, a separate identification process is required for the VAPR initiative.

1. Process Flow

To begin, capability requirements are generated at the center level. Each center ranks and prioritizes the list based on existing criteria established by the MAJCOMs. The centers then submit their prioritized listings to their respective MAJCOMs for coordination and consolidation. The MAJCOMs prioritize the consolidated lists based on their established guidance. Finally, the merged lists are sent to the Air Staff for review.

At the Air Staff level, a board consisting of seven members assigns the final prioritization based on Air Force and Joint Strategic guidance. The board should consist of 5 voting members and two advisory members. The purpose of the board is to prioritize, at the strategic level, capabilities to enhance warfighter capability to meet the Air Force mission. The board consists of:

- A8 – Strategic Plans and Programs
    - Provides long-term planning and programming for the Air Force. Develops, integrates and analyzes the $672 billion Air Force Future Years Defense Program (FYDP) and Long Range Plan to support the national military strategy. Formulates and evaluates options relating to readiness, sustainability, force structure and modernization for SECAF/CSAF.
- A3/A5 - Air, Space and Information Operations, Plans and Requirements (2 positions)
    - Develops Air Force critical infrastructure strategy, policy and objectives, prepares and implements plans and programs, and advocates plans, operations and funding to departmental and governmental agencies.
    - Determines operational requirements, capabilities and training necessary to support national security objectives and military strategy
- SAF/AQ – Acquisition (Co-Chair)
    - Responsible for securing dominant aerospace power, world-class technology, streamlined acquisition, affordable, timely and effective integrated systems, supplies, and services for the warfighter

- SAF/USA – Space Acquisitions (Co-Chair)
    - Air Force professionals providing the nation and the joint warfighter improved aerospace capability through integrated and modernized aerospace systems

Two roles are established as advisory positions to the board:

- Air Force Material Command (AFMC)
- Air Force Space Command (AFSC)

The board consolidates all lists and produces the Air Force Master List. This list is approved by both SAF/AQ and SAF/USA as co-chairs and is finalized for the Air Force. This finalized list is sent to the VAPR SPO. The SPO becomes the process owner and advocate of the Air Force Master List.

Unlike the OnPoint or In-Q-Tel models, VAPR utilizes the prioritization method for ranking technology requirements. As established above, the Air Force creates a Prioritized Master Listing to highlight critical requirements and focus the upcoming venture capital effort on those. OnPoint designates investment focus areas that concentrate on certain, small technology advances. Also, with In-Q-Tel, the CIA doesn't dictate to the firm the specific technologies. It does provide guidance, but unlike the Air Force, doesn't prioritize a list of technologies to pursue.

2. Program Oversight

At the heart of VAPR program is the system program office (SPO). The "SPO concept" has developed gradually since World War II as the development of aircraft, space assets, and associated components became more complex and expensive. Built on General Schriever's experience in managing the Air Force's ballistic missile development program, the SPO consists of a dedicated engineering and procurement cadre together with representatives from the using command(s), including the logistics command. The SPO attempts to anticipate all stages in the development and operational life cycle of a particular system. This underlying theory applies to the VAPR concept.

The Organization of the VAPR SPO follows the standard format as selected by AFMC and SMC. This standardized format has been predominate in the Air Force for decades and is used as the template. The SPO organization:

- Allows early identification of a capability while supporting an evolving requirement definition process
- Minimizes the risk of obsolescence posed by the rapid pace of technology development
- Allows user (SAF/AQ) to make informed decisions based on cost, schedule, and performance
- Predict when a system will require improvements to accommodate future requirements
- Identifies deficiencies within the venture capital application availability of technology insertion, deficiency reports, and systems engineering requirements
- Acts as a single point of contact for all venture capital related actions within the Component

The SPO is subdivided into Area of Responsibilities (AORs) creating specified roles and responsibilities. The SPO AORs and required manpower needed to execute these roles are identified below. The office-specific responsibilities are also identified.

Front Office:

The front office consists of a minimum of four individuals. The VAPR program is commanded by an O-6 or GS equivalent as the SPD. The VAPR/CC (SPD) reports directly to SAF/AQ and is responsible to SAF/AQ for:

- Establishing performance metrics for the Venture Capital firm(s)
- Allocating resources to accomplish Venture Capital objectives
- Forming program objectives
- Developing SPO Strategic goals, vision statement, in support of SAF/AQ strategic goals
- Assessing cost, schedule, or performance against the program baseline
- Conducting source selection and source selection training

The VAPR/CV will:

- Direct SPO in absence of the SPD
- Execute duties as assigned by the SPD

The remainder of the front office is an administrative detail (2 people) assigned to the SPD.

Finance:

The Finance AOR is responsible for supporting the SPD with customer-focused decision support, managing the VAPR SPO resources and assisting with effective and efficient resource stewardship. This position is comprised of 1 financial specialist. The responsibilities are:

- Budget formulation
- Budget Execution analysis
- Funds Certification
- Liaison between the SPO and Contracting

Contracting:

All contracting functions will be provided thru SAF/AQ. Due to the limited contracting requirements needed by the SPO, a separate, collocated contracting office isn't required. The SAF/AQ office will coordinate with the SPD during source selection for the venture capital contract, and with finance for all support/service contracts or needs. The SPO communicates the contracting requirements through the Comprehensive Cost and Requirements System (CCaRs).

AFRL Liaison:

AFRL will provide a point-of-contact for coordinating with the SPO. Collocated personnel support is not needed. However, information sharing between the two agencies is needed.

Engineering Support:

Engineering support (2 positions) is required to ensure technological investments are meeting the AF needs. Their roles are, but limited to:

- Translating technical information into reportable data for SPD
- Reviewing technical reports
- Analyzing performance parameters
- Making recommendations to SPD on future technology needs
- Assessing the condition and applicability of technology investments

- Coordinating with other SPOs for technology inclusion into larger systems (subsystems)
- Coordinating technology advancements between SPO and AFRL

The VAPR SPO will be placed in a geographical location that allows for constant contact and interaction with the venture capital firm and subsequent industry. Co-locating the SPO is imperative to ensure successful collaboration.

The VAPR model has contrasts with both OnPoint and In-Q-Tel concerning oversight. VAPR applies an additional SPO reporting requirement to control the Air force venture capital initiative. MILCOM, a venture-backed company that conceives, creates and launches technology companies in partnership with defense contractors, has oversight of the OnPoint Initiative. MILCOM was chosen by the Army in 2003 to manage the venture capital fund. The Air Force will maintain oversight and control through the SPO. In-Q-Tel is similar to OnPoint with reference to oversight. The companies designated to control venture capital initiatives are in control of the funding place on contract. It is done on behalf of the government agency, with their priorities in mind. If the government agency is not satisfied, contract cancellation is an option each year.

3. SPO/Venture Capital Firm Coordination

The SPO is the single Air Force POC for coordination with the venture capital firm. The interaction between the SPO and the VC firm consists of:

- Relationship management between the Air Force and the VC firm
- Contract negotiation and annual renewal
- Defining critical technological needs
- Assess performance
- Perform coordinated quarterly reviews on cost, schedule, and performance
- Share information on investment activity within the commercial sector
- Consultation between the SPO and VC Firm for assessment of strategic fit and mission value of venture capital transactions
- ensure compliance with business ethics and all applicable laws and regulations

All other responsibilities will be addressed as needed within the language of the contract vehicle. The driving principle is that the U.S. Air Force needs to seek technologies that will vastly increase the effectiveness of our airmen. The VC/Air Force relationship is built on the concept of addressing the needs of the service, proactively seeking out technology advances, both traditional and non-traditional means, and provides reach-back capability for the acquisitions processes that dominate the Air Force procurement model.

C. FOR PROFIT VS. NOT-FOR-PROFIT

Many arguments can be made concerning using a for-profit or a not-for-profit schema for the VC contractor for the VAPR program. The CIA's contractual relationship with In-Q-Tel is a not-for-profit set up using a fixed price contract. In-Q-Tel's profits are taken from the difference in cost to execute the program and the amount of money contracted for that year. Rosettex (the NGA's VC arm), on the other hand, is a for-profit arrangement. According to their agreement with the government 75% of the returns from investments plus the original investment are returned to the fund for future investments. The remaining funds are profits retained by Rosettex.[80]

Choosing for-profit versus not-for-profit depends primarily on two decisions; 1) creating a fund that is self-sustainable, or one that requires continuous funding and 2) incentivizing the contractor to attain the greatest returns.

1. Self-Sustainability vs. Continued Funding

Today's resource environment and its finite nature preclude decision makers from supporting too many programs that are resource intensive by nature. For this reason the VAPR program must take an approach that minimizes the use of resources in the long-term. Minimizing long-term resource reliance allows the USAF greater flexibility for funding other future MDAPs. For this reason, a self-sustaining fund is necessary for the VAPR program to provide technologies to the Air Force over the long-term with minimum drain on finite resources.

[80] B.M. Chachula. (2004). *Evaluate initiation of an air force venture capital fund* No. WBI-2004-1). Ohio: Wright Brothers Institute.

Seed money is required to begin a self-sustaining venture capital fund. To minimize long-term use of financial resources we must first determine how long the seed money is required. This is determined by investigating how long it takes before investments begin providing returns. Return time is needed because the estimate of time determines when the last year of seed money is required based on size of returns. For example, if the investments from the first year's investments pay out in year five then that year's funding requirement should be reduced by that return amount (less profit). Eventually, enough returns add up completely making up for the seed money at which time seed money is no longer required.

The analysis of investment return times was conducted focusing primarily on *late-stage* investments because, on average, late stage investments require two years before they provide a return.[81] While investing in stages other than late-stage investments is not prohibited it does increase the length of time required before seeing a return on the investment. Additionally, the late-stage approach is in line with the desire for the VAPR program to rapidly transfer new technologies. Not only does it provide a quicker return, but it allows the AF to leverage its funding off of already existing investments by providing funding to push the investment past the final stages and to the market/warfighter.

In the interest of conservatism we took into account the failure rates associated with VC funds as discussed in Chapter IV. This is done by using the optimal fund sizes created in Chapter IV of this paper. Since the failure rates are already built into the optimal investment sizes we did not deduct an additional amount in this section when computing returns based on the investment amounts. To do so would double count the failure rates and distort potential earnings.

As stated above, the average time late-stage VC funds require to see the returns on their investments is two years. Additionally, the average pooled IRR for late-stage investments is, on average, 13.6%. Reference Table 9 below for IRR details for each type of fund:

[81] L. Himelstein, P. Burrows, & A. Reinhardy. (1997). *The great hunt for hot ideas.* Retrieved September 21, 2006, from http://www.businessweek.com/1997/34/b354140.htm.

Table 9. IRR Details

Cumulative Fund Type		Calculation Type: IRR				Primary Market: US			
Fund Type	Num	Avg	Cap Wtd Avg	Pooled Avg	Max	Upper	Med	Lower	Min
Early/Seed VC	558.00	16.00	6.50	19.60	721.00	15.70	2.70	(7.00)	(54.70)
Seed Stage VC	65.00	9.60	1.90	9.90	257.70	13.30	3.90	(3.60)	(27.50)
Early Stage VC	493.00	16.80	6.70	20.50	721.00	15.90	2.60	(7.30)	(54.70)
Balanced VC	444.00	9.60	5.60	14.20	195.20	15.10	5.50	(1.20)	(86.10)
Later Stage VC	188.00	11.00	6.20	13.60	209.20	15.60	5.10	(1.20)	(100.00)
Total Inv/Avg IRR	1,748.00	12.60	5.38	15.56	420.82	15.12	3.96	(4.06)	(64.60)

If we apply the average return time to the average amount returned we see the seed money can be completely replaced, on average, with investment returns within two years.

It is important, however, to look at investment return times and amounts for VC funds other than later-stage funds. This is because it is improbable that enough later-stage technologies will exist at the time of investment to satisfy the amount of money the AF wants to invest. Subsequently, an analysis comparing "early-stage" funds, "average" funds and "later-stage" funds was conducted. Table 10 below illustrates the returns of each fund and how long each fund takes before seed money is no loner required. The numbers listed in below in Table 10 include a 25% award fee. This will be discussed in greater detail in the subsequent section.

Table 10. USAF Return on Investment

IRR, Early-Stage (20.50%)					FY07$ Millions					
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
AF Investment	74.805	74.805	74.805	74.805	74.805	74.805	86.30627	86.30627	86.30627	86.30627
Return	0	0	0	0	0	86.30627	86.30627	86.30627	86.30627	86.30627
IRR, Balanced (14.20%)					FY07$ Millions					
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
AF Investment	74.805	74.805	74.805	74.805	74.805	74.805	74.805	74.805	82.77173	82.77173
Return	0	0	0	0	0	0	0	82.77173	82.77173	82.77173
IRR, Later-Stage (13.60%)					FY07$ Millions					
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
AF Investment	74.805	74.805	74.805	82.43511	82.43511	82.43511	90.84349	90.84349	90.84349	100.1095
Return	0	0	82.43511	82.43511	82.43511	90.84349	90.84349	90.84349	100.1095	100.1095

2. Incentivizing the Contractor

Now that we have determined the AF is best supported with a self-sustaining VC fund we must now determine how to best incentivize the contractor to obtain the greatest

returns possible. While In-Q-Tel has had success with their fixed price contract model they are not a self-sustaining fund. They use one-year options as the carrot for their contractor to perform. While they are providing an award fee as part of the FFP contract they can cancel the program at anytime due to poor performance.

VAPR requires a slightly different approach due to its self-sustaining approach. In fact, the best approach is one that was mentioned earlier as used by Rosettex. To incentivize the contractor to obtain the greatest returns one must tie the contractor's fee to the returns themselves. In line with this theory, the VAPR program offers the contractor a 25% award fee. Using a percentage allows the award fee to fluctuate with the returns. The greater the return the contractor achieves the greater the award fee will be.

While this award fee in line with Rosettex's model it is differs from the In-Q-Tel model. In-Q-Tel's pay philosophy is focused on aligning pay with performance and with fulfilling the company's mission-how well the company and its employees achieve mission goals in serving the CIA and the IC.[82] VAPR, while it doesn't incentivize individual members, it does incentivize the company for meeting performance goals, as outlined above.

The award fee for the VAPR program is best supported with a FFP contract vehicle. The FFP contract does not provide funding for the contractor's operations. Instead, it is strictly set up to provide funding for the VAPR program's investments. It does include verbiage, however, to allow for the contractor to be awarded 25% of the investments returns. Additionally, the contract must be set up to have the original investments returned to a pool for future investments. This, in essence, is the basis for the self-sustaining fund.

Unfortunately, tying the contractor's profits directly to the returns of each investment can promote an investment strategy that doesn't pick the technology best suited for the AF, but one that provides the best return. To prevent the contractor from picking investments strictly based on return rates the contract will be set up with one-year

[82] In-Q-Tel. *Investing in our nations security.* Retrieved November 4, 2006, from http://www.in-q-tel.com/about/index.htm#Overview.

options. Using the one-year options provides the Air Force with the ability to cancel the contract if they don't feel the investments are being made in the best interest of the Air Force overall.

D. FUNDING

The funding required for the VAPR program is in direct relation to the self-sustainability of the program. Since we elected to use a self-sustaining fund over a continuously funded VC fund we must address how to budget for such a program. The VAPR program initially requires seed money to get started and remain viable for the long-term. This brings up two areas that must be addressed; 1) how much seed money is required each year and 2) how many years does the USAF provide the seed money.

Table 10, above, illustrated three VC stages and their subsequent return times and amounts. Also, as noted earlier, it is unlikely the contractor will only be able to invest in later-stage technologies albeit that is the goal. Therefore, it is most likely a balanced approach will happen resulting in an average IRR of 14.2%. Additionally, based on receiving $74.805M for ten investments (based on Table 7) it is estimated the Air Force must provide funding for approximately eight years before the fund begins to pay for itself. This estimate is based on returns occurring during around 7.5 years. Therefore the AF must fund the beginning of the eighth year. Table 10 shows that in year eight the returns, plus original investments, minus award fees equate to a fund of approximately $82.772M.

The VAPR funding strategy differs when compared to other DoD VC models. First, it requires seed money due to its goal of self-sustainment within eight years. This is vastly different from the OnPoint initiative, which requires additional, appropriated funding each year. Also, the funding range for VAPR is approximately $15K to $16M per VEIC in the priority list. This is an extreme range when compared to OnPoint investments, which typically range from $500K to $2M.

E. MEASURES OF SUCCESS

As stated above, one of the main roles of the VAPR SPO is to monitor performance of the fund. This is done in a variety of ways. There are, however, two

important measurements that must be considered when discussing fund performance. First, it is important to know how much of a Return on Investment (ROI) has been achieved. This will determine how much bang for the AF's buck the VAPR program is generating. Second, an Internal Rate of Return must be managed. This measurement will take into account the time value of money concerning VAPR investments. These two measurements are discussed in detail below and will be monitored quarterly by the VAPR SPO as indicators of growth and fund success.

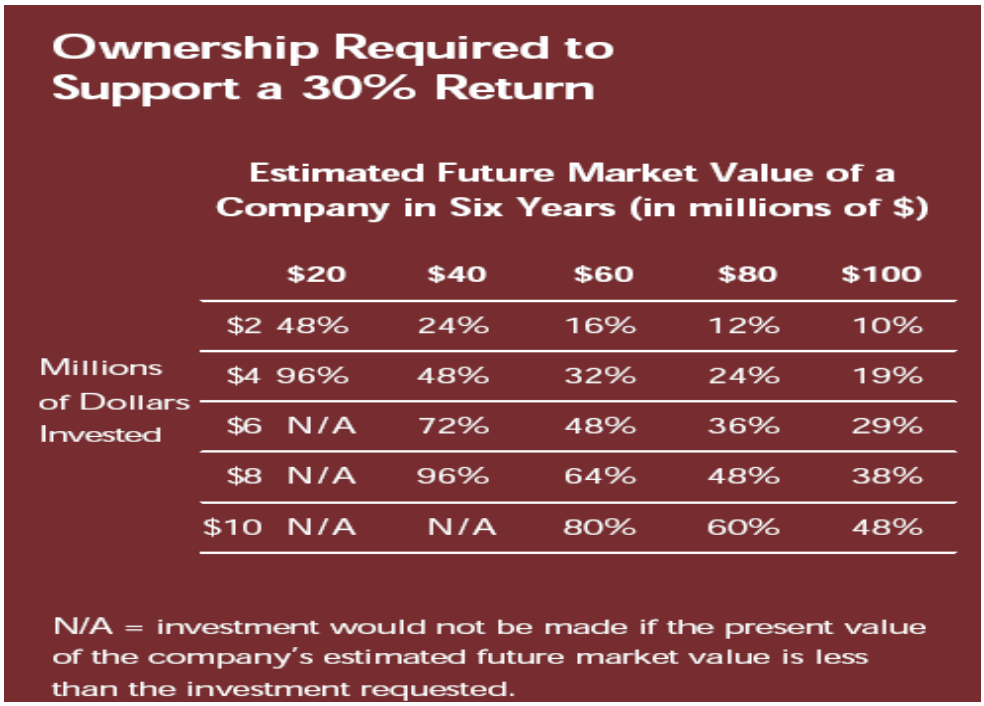
1. ROIs

Return on Investment formula (ROI = Net Profit / Amount Invested) will be used to determine acceptable levels of growth from each investment. However, there are some concerns that must be addressed when using ROI to value projects.

ROI calculations may over-value investments since the calculations are often slanted to favor short-term cost savings and overlook long-term costs such as maintenance, support and integration costs. Additionally, The ROI calculation does not take into account time value of money or risk associated with the project or investment. The time value of money concept says that a dollar today is worth more than a dollar tomorrow. This is especially true when considering other investment alternatives and the effect of inflation from a macro economic perspective. Finally, the many ways to calculate ROI creates a problem of consistency in companies. Few companies have developed a consistent ROI methodology thus making it difficult to accurate compare the value of multiple projects. In an attempt to address the inconsistency problem the formula listed above will be used for valuing all VAPR projects.

In support of calculating ROI for investments, Price Waterhouse Coopers has created a table to illustrate the growth needed to match a particular investment and yield a 30% return.

Table 11. Growth Required to Meet Yield Requirement (From: PriceWaterhouseCoopers)



Ownership Required to Support a 30% Return

Millions of Dollars Invested	Estimated Future Market Value of a Company in Six Years (in millions of $)				
	$20	$40	$60	$80	$100
$2	48%	24%	16%	12%	10%
$4	96%	48%	32%	24%	19%
$6	N/A	72%	48%	36%	29%
$8	N/A	96%	64%	48%	38%
$10	N/A	N/A	80%	60%	48%

N/A = investment would not be made if the present value of the company's estimated future market value is less than the investment requested.

The preceding table, created by Price Waterhouse Coopers[83], is a listing of what venture capitalists typically invest based on the estimated growth of the company being invested in. The AF, in conjunction with its contractor, should use a similar approach to the one used in the table above to ensure an adequate return is reached.

2. IRR

One benefit IRR has over ROI is that it addresses the time value of money issue. IRR is a discount rate (return rate) at which the present value of a series of investments is equal to the present value of the returns of those investments.[84] This is a sound measurement for use by the VAPR SPO due to its ability to measure irregular investments and subsequent sales of those investments. As investments are made, IRR's

[83] Price Waterhouse Coopers, 9th Ed., Three Keys to Obtaining Venture Capital, Pricing and Control: The Investor's Perspective (p. 6).

[84] C. Yost, & R. Carreiro. (1999). *Analysis - internal rate of return (IRR).* Retrieved November 6, 2006, from http://www.investopedia.com/offsite.asp?URL=http://invest-faq.com/articles/analy-int-rate-return.html,

true usefulness can be utilized. IRR provides the ability to compare potential investments. While the main goal of the VAPR program is rapid transference of technology, it does not make sense to invest in a technology you can acquire in two years if you lose money on the return. For this reason, IRR will serve as the main methodology for selecting between investments.

F. SUMMARY

The VAPR model's overarching goal is to rapidly transfer technologies to the warfighter. The model is designed to take advantage of existing VC models within the DoD by implementing their various aspects to best fit Air Force needs. This is similar in respect to OnPoint. While VAPR works on a much broader scale, its goal of rapid technology transference is identical to On Point's goal. As stated on OnPoint's website, it is designed "to accelerate the transition of new, or significantly improved, technologies into the U.S. Army."[85] Additionally, by setting up VAPR to be self-sustaining (through up-front seed money) the Air Force can create a long-term VC fund without tapping future resources. To ensure a successful program the SPD will use ROI and IRR as measures of profitability and a means for comparing projects respectively. Its ability to move technology from the private sector to the user in conjunction with its design to satisfy *capability* requirements allows VAPR to meet Air Force needs quickly and at minimal cost.

[85] In-Q-Tel. *OnPoint history*. Retrieved November 4, 2006, from http://www.onpoint.us/about-us/index.shtml.

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VI. CONCLUSION

The research accomplished for this document shows that the Air Force could benefit from a venture capital initiative. This conclusion was drawn as the exploration of the traditional acquisition process, other Air Force programs, and how a venture capital initiative might fit within these existing programs was accomplished. While we came to the same conclusion as previous research efforts by Bernard Chachula when he wrote "Evaluate Initiation of an Air Force Venture Capital Fund" for the Wright Brothers Institute in 2004, our research was focused on the current processes and than selecting what we thought is the best approach to implementing a venture capital initiative.

The traditional acquisition process is essentially a risk management tool. This tool is effective in minimizing the risk of failure on programs and assigning multiple parties to be accountable. To minimize those risks DoD has sacrificed flexibility and timeliness. Minimizing those risks are important because it is demanded by the American public who trust us to achieve success with the funds they provide. However, with the pace of technological change increasing by the time an acquisition program is actually delivered there is the increased risk of technological obsolescence in the field. Add to this the fact that our current enemies are constantly changing the methods used to employ violence against our forces, and it can be seen why venture capital may be a possible tool to achieve newer technologies faster than the traditional process.

In addition to the traditional method of acquisition, the Air Force also utilizes multiple other, smaller programs, to achieve technology developments. These programs included:

- CRADA
- EPA
- PIA
- TIA
- SBIR

All of these programs provide a way for the Air Force to interact with universities and other research oriented organizations to achieve a technological advantage. The

SBIR program acts just like a venture capital initiative by providing funds to small businesses trying to bring a new idea into reality. However, as talked about in Chapter III the programs have two potential flaws. One potential flaw is the concept of "technology transference" which the Air Force technology transfer handbook defines as "process by which existing knowledge, facilities, or capabilities developed under federal research and development (R&D) funding are utilized to fulfill public and private needs."[86] This definition implies that the research is conducted in the public sector using public sector funds and than transferred to the private market to push for more uses of that technology. The goal of a venture capital initiative would be to leverage private sector resources to obtain technology developed in the private sector for use by the warfighter. The second potential flaw was the scale of the programs. The SBIR program, which acts just like a venture capital initiative, can only provide $850,000 for development of an idea into a usable product. This amount does not provide for the average investment needed in several areas of research, as discussed in Chapter IV, to be successful. With the traditional process being slowed down by bureaucracy and the other than traditional programs available not of the necessary scale to achieve a usable product the research turned to the role a venture capital initiative would play in complementing the existing programs.

A venture capital initiative provide the Air Force with a tool that can move faster and be more flexible than the traditional process while maintaining a scale beyond that of other than traditional programs. The program can be more flexible because, as discussed in Chapter IV, the money and the capabilities needed are provided to a venture capital firm who then finds prospective companies to invest in. By moving the process outside the bureaucracy of the Air Force, the company can make choices faster to provide the best return for the government and in turn themselves. In order to be effective, the Air Force must decide which categories to focus the venture fund on and then fully fund the categories selected. Chapter four provided an example of a five and ten category investment fund and the appropriate size of those funds. Full funding provides the

[86] AFRL. (1/17/2002). Air force technology transfer handbook. Retrieved August 1, 2006 from http://www.dtic.mil/techtransit/.

venture fund with the necessary resources to achieve the objectives the Air Force asks it to achieve. One of the causes for delays and cost increases in the traditional model is the inability of the government to guarantee the contractor that funds will be available to continue the program if they are achieving the goals set by the government. This causes more contracts to be written and causes the contractor to price in the risk of not continuing a program. Through the exploration of the role of venture capital as a tool for the Air Force the questions of how the Air Force model would look and operate came into mind.

The Venture capital Applied Procurement Response Model (VAPR) provides the Air Force with the ability to rapidly transfer technology to the warfighter. The model, as discussed in Chapter V, takes attributes of multiple models, including the CIA's In-Q-Tel and the Army's OnPoint models, and builds one the Air Force can use to implement VAPR. The Air Force side of the model operates like a SPO in interacting with the venture capital firm and providing the oversight needed when using government funds. While the Air Force plays no role in the actual selection of the companies the venture firm will invest in, the Air Force provides a list of the needs and on an annual basis performs an evaluation of the venture firms efforts to determine if the contract with them will continue. This is an attempt to obtain goal congruency for the government and the contractor. With the appropriate personnel and the latitude to execute the mission, as outlined in Chapter V, the VAPR model could provide the Air Force with the appropriate means to achieve success in obtaining new technologies quickly for the Air Force.

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